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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Evaluation of Water-Thinned Preconstruction Primers Containing No Metal Pigments

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
Peterson Builders, Inc.

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DISCLAIMER

EVALUATION OF WATER-THINNED PRECONSTRUCTION PRIMERS CONTAINING NO METAL PIGMENTS

NATIONAL SHIPBUILDING RESEARCH PROGRAM

NSRP 3-95-3

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August 1997

FORWARD

This final report presents the results of a project entitled, "Evaluation of Water-Thinned Preconstruction Primers Containing No Metal Pigments," that was conducted by McDermott Technology, Inc. (formerly the Babcock & Wilcox Research and Development Division) of Alliance, OH. Work in the project was done under subcontract to Peterson Builders, Inc. (PBI) of Sturgeon Bay, WI for the National Shipbuilding Research Program (NSRP). The project was sponsored by the Surface Preparation and Coatings Panel (SP-3) of SNAME's Ship Production Committee under the technical direction of Mr. John Meacham of PBI, NSRP Program Manager.

The research for this 18-month project was initiated by Mr. Dwight L. Turner (formerly of the Babcock & Wilcox Research and Development Division) on February 7, 1996. Project leadership responsibilities were later assigned to Mr. Walter R. Mohn of McDermott Technology, Inc. on October 1, 1996 who oversaw completion of the workscope throughout the remaining period of performance that ended on June 18, 1997. While preparation of test panels was done at McDermott Technology, Inc. in Ohio, the plasma arc cutting tests, fillet weld tests, and 12-month atmospheric exposure tests were conducted at the Bollinger Shipyard (formerly the McDermott Shipyard) in Morgan City, LA.

EXECUTIVE SUMMARY

The primary goal of NSRP Project 3-95-3 was to identify and evaluate water-thinned preconstruction primers (PCP's) which could potentially be used as viable substitutes for conventional PCP's containing powdered zinc and high levels of volatile organic compounds (VOC's). The objectives of this 6-Task, 17-month project were to compile a comprehensive list of commercially available water-thinned preconstruction primers (PCP's) which contain little or no hazardous metal and to evaluate the more promising candidate PCP's by laboratory and shipyard testing. In this work, selected PCP's were evaluated for weatherability, compatibility with follow-on coatings, cutting performance, and weldability per MIL-STD-248D.

In Task 1 of this project, available information on water-thinned PCP formulations manufactured by commercial paint vendors was compiled. This information included product data sheets, vendor research reports, and data available from the shipyards. This information was then used to down select the candidate PCP's for subsequent laboratory and field testing. Selected PCP's were Amercoat 3207 (manufactured by Ameron Protective Coatings Group), Carboline 8101 (manufactured by Carboline Co.), Devran 720 (manufactured by Devoe Coatings), Hemudur 18580 (manufactured by Hempel Co.), Intergard 292 WB (manufactured by International Courtaulds), and Sovaprime 13R96 (manufactured by Jotun Valspar). For comparison, two relatively new inorganic zinc (IOZ) primers containing VOC's were also chosen for testing, including WB14A (manufactured by International Zinc) and Nippe Ceramo (manufactured by Nippon), both of which were of keen interest to several shipyards.

In Task 2 of the project, the test panels needed for laboratory and field tests were prepared. All adhesion and atmospheric exposure test panel substrates were made from 3/16 inch thick ASTM A36 steel grit blasted to achieve a "near-white" surface finish per SSPC SP10. Fillet weld test panel substrates and plasma torch cutting test panel substrates were both made from 3/8 inch thick A36 steel grit blasted to SSPC SP10. Each PCP was applied to establish three dry film thicknesses (DFT's of 0.5, 1.0, and 1.5 mils) representative of low, medium and high shipyard application conditions. For adhesion testing, each manufacturer's recommended overcoats were applied to test compatibility with the PCP. Results of Elcometer adhesion tests showed that all of the coatings displayed good adhesion, most exhibiting strengths greater than 1000 psi.

In Task 3 of the project, PCP-coated steel plates were severed with a plasma torch to assess the condition of the resultant cut. Cutting trials were conducted on an automated plasma torch cutting machine used in production operations at the McDermott Shipyard (now Bollinger Shipbuilding, Inc.) in Amelia, LA. Traverse speed for the cuts was set at 121 inches per minute. Severed panels were subsequently examined, and the surfaces of the kerf were rated either good, fair, or poor. Results showed that all panel cuts were rated as good.

In Task 4 of the project, PCP-coated panels were fillet welded to assess quality and condition of the fusion joints in accordance with MIL-STD-248D. Welding trials were conducted with a Lincoln twin-arc welding machine used in production operation at the McDermott Shipyard. Primer was not removed, cleaned, or otherwise treated prior to fillet welding. For this test, a linear welding speed of 10 inches per minute was used based on recommendations of experienced production welders at the shipyard. After welding, each web-and-flange assembly was subjected to destructive testing, and significant linear porosity was observed along the fusion centerline in most of the fillet welds. These results indicate that under these specific conditions, the PCP's may have to be removed to produce acceptable weld joints. While it was not within the established workscope of this project, it is recommended that additional testing be conducted to identify alternative welding parameters for making acceptable welds on panels with these coatings.

In Task 5 of the project, PCP-coated test panels were scribed and submitted for atmospheric exposure testing at the (former) McDermott Shipyard in Amelia, LA. The twenty-four carefully prepared panels (8 PCP's X 3 DFT's) were mounted on a KTA test rack and positioned for a southerly exposure in a safe location at the top of a building at the shipyard. Exposure testing was initiated on June 17, 1996. Periodic 3-month inspections of the panels were conducted thereafter in accordance with ASTM D610-85 (scale of 0 to 10 where 10 is best) to document their condition. Atmospheric exposure testing was completed on June 23, 1997 when the panels were removed from the test and shipped to McDermott Technology in Alliance, Ohio for final assessment. Results showed that fourteen of the eighteen panels that were coated with water-thinned PCP's were rated from 1 - 7, and of these, the lowest ratings generally correlated with DFT's of 0.5 mil. Panels rated above 7, all of which had a nominal DFT of 1.0 mil or greater, were coated with either Amercoat 3207, Devran 720, or Hemudur 18580. Panels coated with IOZ primers Nippe Ceramo and WB14A were rated 7 or 9, except for one Nippe Ceramo-coated panel (rated 1) having a DFT of 0.5 mil.

Task 6 involved the technical management and reporting (including interim progress reports, quarterly reports, and the final report) which were conducted throughout the duration of this 17-month project.

ACKNOWLEDGMENTS

The interest and participation of many contributors helped to ensure the relevance and success of this project, including: Mr. John Meacham of Peterson Builders, Inc., NSRP Program Manager; Mr. Walter Fortenberry of Newport News Shipbuilding, Advisory Committee Chairman for this SP-3 Panel Project; Ms. Christine Stanley of Ameron Protective Coating Systems, Advisory Committee Member; and Mr. Derrick Hayman of Jotun Valspar Marine Coatings, Advisory Committee Member. The consultation and advice given by Mr. Dwight L. Turner of Alliance Midwest Tubular Products (formerly of McDermott Technology, Inc.) are also greatly appreciated. The assistance of Mr. Barry L. Conrad of McDermott Technology, Inc. is gratefully acknowledged. Particular recognition is directed to the companies which supplied the candidate preconstruction primers and associated materials for this project, including Ameron (Amercoat 3207), Carboline (Carboline 8101), Devoe (Devran 720), Hempel (Hemudur 18580), International Courtaulds (Intergard 292 WB), Nippon (Nippe Ceramo SW NQA 993/997), and International Zinc (WB14A). The support and concerted efforts of several talented people at McDermott, Incorporated and at Bollinger Shipbuilding, Inc. (formerly McDermott Shipyard) were instrumental in the successful completion of this project. Mr. Vic Mitchell of Bollinger was particularly helpful in preparing the atmospheric exposure panels for inspection.

FINAL REPORT OUTLINE - NSRP 3-95-3

Evaluation of Water-Thinned Preconstruction Primers Containing No Metal Pigments

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1.0 INTRODUCTION AND BACKGROUND

1.1 Needs within the Shipbuilding Industry

Concerns regarding safety, health and protection of the environment, in addition to the cost and functional effectiveness, have become critical considerations in the selection, use and application of protective coating materials in the shipbuilding industry. In fact, the relatively new rules limiting the allowable levels of VOC's and content of metallic pigments have become the major driving force behind efforts to reformulate coatings and to revise specifications for industrial marine paints and preconstruction primers (PCP's).

It has been standard shipyard practice for years to grit blast incoming steel and prime it with a thin layer of inorganic zinc (IOZ) primer, since this coating is very effective in preventing steel corrosion during storage and fabrication. Such primer is usually applied in a dry film thickness (DFT) of 0.5 mil to 1.5 mils. The tough, thin IOZ layer allows thermal cutting to proceed without interruption and can be fused and bonded by welding processes commonly used in the shipyard.

Despite the attributes of IOZ primers, there are some disadvantages with these coatings. IOZ primers are composed of 20 to 70% powdered zinc, depending on the manufacturer's formulation. This metal has come under increasing scrutiny by state and federal agencies, including the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA). Metallic zinc dust from production operations or from paint disposal can leach into natural aboveground and below-ground water supplies. Toxic zinc fumes are also generated during thermal cutting and welding operations. These fumes can cause welding arc instability and increased weld spatter. Use of IOZ primers can also result in the degradation of weld joint quality by causing excessive porosity, especially in fillet welds. Mechanized welding of IOZ primer-coated steel can increase the incidence and content of porosity in the solidified joint because of the high welding speeds and rapidly freezing weld pool.

A special concern with older inorganic zinc formulations is the relatively high VOC content. Conventional PCP's contain as much as 3 to 5 pounds per gallon of volatile organics. Although low-VOC, waterborne IOZ preconstruction primers have been recently introduced, they tend to be more difficult to apply successfully. Experience at the McDermott Shipyard (now Bollinger Shipbuilding, Inc.) has shown that these primers can cause work stoppages due to frequent plugging of spray equipment. Waterborne IOZ primers are also more sensitive to substrate cleanliness and to weather conditions during application and curing.

In recent years, coating technologists and product formulators have made significant advancements aimed at reducing emissions of VOC's, as well as metal compounds from the pigment base. A wide variety of waterborne or water-thinned PCP's containing no metal pigments have been developed for use in the shipbuilding industry, as well as in other types of marine construction. Although new environmentally acceptable preconstruction primer systems had been commercially available, relatively little was known about their dependability, consistency, and long-term performance. Coating specifiers were often forced into specification decisions based on environmental acceptability alone, rather than a sensible combination of environmental acceptability and PCP performance. The need for information on the characteristics and performance of some of the newer PCP's established the basis for this NSRP project. Accordingly, the work in NSRP Project 3-95-3 focused on the evaluation of water-thinned PCP's containing no metal pigments, and the results provide a direct response to a common need for information on these primers throughout the shipbuilding industry.

1.2 Project Benefits

The goal of this project was to identify and evaluate water-thinned PCP's which could be used as viable substitutes for conventional PCP's containing powdered zinc and high levels of VOC's. The results will provide significant benefits toward the selection and use of alternative, environmentally compliant PCP's for shipyard use. Engineering specifications for new PCP's are now based on meeting the current regulatory VOC limits of 3.5 lbs/gal. and containing no compounds of lead, chromium, barium, mercury, and cadmium. Shipyard use of the best performing PCP's identified and evaluated in this project will serve to meet these regulations and the even more stringent regulations (2.8 lbs/gal VOC limit) being considered by the EPA for the near future.

1.3 PCP Materials and Processes

The PCP's selected for evaluation in this project were as follows:

Amercoat 3207	(Manufactured by Ameron)
Carboline 8101	(Manufactured by Carboline)
Devran 720	(Manufactured by Devoe Coatings)
Hemudur 18580	(Manufactured by Hempel)
Intergard 292 WB	(Manufactured by International Courtaulds)
Sovaprime 13R96	(Manufactured by Jotun Valspar)

For comparison, the following IOZ primers were included in the evaluation:

WB14A	(Manufactured by International Zinc)
Nippe Ceramo	(Manufactured by Nippon)

ASTM A36 steel sheet and plate were used to fabricate test panels for this project. Prior to the application of coatings, panels were given an abrasive blasted to establish an SSPC SP10 (near-white) surface condition. All primers and overcoats were furnished by the manufacturers in five gallon containers at no cost to the project. Each coating was mixed and applied in accordance with the manufacturer's recommendations to establish nominal dry film thicknesses (DFT's) of 0.5 mil, 1.0 mil, and 1.5 mils.

1.4 Technical Approach

Test panels that were prepared for this project included the following:

24 adhesion test panels (1/4" X 4" X 6")
24 atmospheric test panels (1/4" X 4" X 6")
24 plasma torch test panels (3/8" X 12" X 24")
24 weld test panels (3/8" X 4" X 20")

Some of the panels were given overcoats with follow-on paints (recommended by the PCP manufacturer) to determine compatibility and to test adhesion per ASTM D4541. The tests which were conducted to evaluate the coated panels included 1) adhesion, 2) plasma torch cutting, 3) welding, and 4) atmospheric exposure.

All atmospheric exposure panels were scribed on the front face to expose the steel substrate for testing. This scribe mark provided data on the effect of construction damage which sometimes occurs during shipyard operations. The panels were then attached to an insulated rack having a galvanized steel frame (purchased from KTA-TATOR, Inc., Pittsburgh, PA). The rack with the 24 panels was mounted in a secure location on top of a building at the McDermott Shipyard (now Bollinger Shipbuilding, Inc.) in Amelia, LA. The rack was oriented toward the south at an angle of 45% from the horizontal to obtain maximum exposure from the sun. Records of daily weather conditions for the 12 months of testing were obtained from the National Weather Service for Morgan City, LA to document the exposure data. Panels were visually inspected and photographs at 3-month intervals during the course of exposure testing.

2.0 PROCEDURES AND TESTING

2.1 Task 1: Survey of the Coatings Industry

The goal of Task 1 was to compile all available information on water-thinned PCP formulations manufactured by commercial paint vendors. The information was to include product data sheets, vendor research reports, and any data available from the shipyards. This allowed for assessment of the individual coatings for possible inclusion in the project test matrix. The information was then used to down-select candidate water-thinned PCP's for subsequent laboratory and field testing.

2.1.1 Survey Methodology

Online databases including METADEX, NTIS, ASM International, Engineering Index, Engineering Materials Abstracts, and U.S. Patents were searched for recent developments with water-thinned PCP's. The JPCL 10-year CD-ROM Archive was also searched using the key words: waterborne, water-thinned, primer, preconstruction, and shop primer.

Several U.S. shipyards were contacted to gain the benefits of their experience with PCP's. Table 2-1 presents a summary showing the results of this effort and shows the variation in types of PCP's which were being used. Two of the shipyards reported using water-thinned PCP's on an occasional basis, while two others responded that they were using them routinely. Both routine users found that preheat and post heat are required on automated paint application lines to accelerate drying of water-thinned PCP's, citing typical drying times of less than five minutes. Other shipyards contacted were using solvent-thinned and water-thinned forms of IOZ primers, including International Zinc WB14A and Nippon Nippe Ceramo.

A number of well-known coating suppliers, as well as other paint and primer suppliers listed in the JPCL Buyer's Guide and the Thomas Register, were contacted to gain information on their PCP products. Industrial, architectural, and marine paint manufacturers were also contacted. Some of the manufacturers did not offer PCP's, while others did not produce PCP's for marine use. Table 2-2 presents a summary of the companies which were included in this part of the survey.

2.1.2 Selection of PCP Candidates

Based on the information gained in the survey of the coatings industry, a listing of nine candidate water-thinned PCP's was prepared for final consideration. Six of the more promising ones were down-selected from this listing for laboratory and field testing. In addition, two popular IOZ primers were included in the evaluations for comparison, as shown in Table 2-3. All eight coatings were commercially available and had been tested or used by at least one shipyard. Product data sheets for each of the coatings are provided in Appendix 2-1.

2.2 Task 2: Test Panel Preparation

The goal of Task 2 was to prepare all test panels required for subsequent laboratory and field tests. Each PCP was to be applied in three DFT's (0.5 mil, 1.0 mil, 1.5 mils) representative of low, medium, and high shipyard application conditions. Four types of panels were prepared for welding, cutting, adhesion, and shipyard exposure testing. During preparation, and prior to the application of PCP coatings, fabricated steel plates were called substrates. Not until the PCP coatings had been applied and cured (dried) were the steel plates referred to as test panels.

2.2.1 Calibration of Measuring Equipment

Table 2-4 lists the equipment which was used to record coating application data. Each instrument was checked to verify accuracy and traceability to nationally recognized standards.

2.2.2 Fabrication of Steel Test Panel Substrates

All adhesion and atmospheric exposure test panels substrates were made from a single sheet of 3/16 inch thick ASTM A36 steel. This thickness was the thinnest A36 sheet that could be purchased with mill test certificates.

All fillet weld test and cut test panel substrates were made from a single sheet of 3/8 inch thick A36 steel. The fillet weld test panels (3/8" X 4" X 20") were sized to conform with MIL-STD-248. The cut test panels (3/8" X 12" X 24") were sized to permit multiple cuts on production plasma arc cutting equipment at the McDermott Shipyard.

The design of the atmospheric exposure test panels (Figure 2-1) was configured to allow mounting on a standard KTA paint test rack. Each panel substrate had one 3/8 inch diameter hole punched in the bottom to facilitate handling. All sharp corners were chamfered 1/32 inch to prevent "rust-back" at the edges. Before abrasive blasting, each test panel was solvent cleaned with reagent grade acetone to remove any residual oil or grease. Panel substrates were then identified with numbers stamped on the front and back.

2.2.3 Panel Substrate Surface Preparation

The back surface of each atmospheric exposure panel substrate was grit blasted to establish SSPC SP10 "near-white" condition with a surface profile between 1.0 and 1.5 mils, as recommended by the PCP manufacturers. Press-O-Film coarse replica tape and a Testex spring micrometer (Figure 2-2) were used to determine the test panel substrate surface profile after shot blasting.

Figures 2-3 and 2-4 show the Vacu-Blast equipment that was used for all surface preparation. Several grades of steel abrasives had to be tested to determine which would establish a surface conforming to SSPC SP10. Standard steel shot sizes ranging from S280 to S70 were evaluated, as well as steel grit ranging from G120 to G40. Since the lowest surface profile (1.5 mils) was attained with S70 shot, this grade was selected for use in preparing the surfaces of all test panels in the project. Visual standard SSPC VIS, 1-89 was used to ensure that the preparation of the panels met SSPC SP10 surface conditions.

As a precaution against chloride contamination of the panel substrate surfaces, chemical testing of a few substrate surfaces (in accordance with ASTM D512) was conducted after shot blasting. Detection of only a minute amount (less than 0.0003 mg/cm2) of chlorides showed that there was virtually no chloride contamination of the panel substrate surfaces. A summary of these findings is documented in Appendix 2-2.

2.2.4 Application of Paint to Test Panel Substrates

The back surface of each atmospheric exposure panel substrate was blasted to SSPC SP10 and coated with Devoe Bar Rust 235 surface tolerant epoxy paint, as shown in Figure 2-5, to prevent rusting during testing. This was done to reduce the possibility of back surface rusting from confounding the results for the front, exposed panel face.

All primers and overcoats used in this evaluation to coat the front surfaces of the panel substrates were furnished by the manufacturers in five gallon containers at no cost to the project. Coatings were mixed and applied in accordance with each manufacturer's recommendations. To prevent the formation of flash rust, prepared panel substrates were stored in a dry location, and primers were applied before any visual indications of flash rusting appeared. To simulate conditions of shipyard production, all panel substrates were warmed to 100%F before and after PCP application. Both conventional air spray equipment and airless spray equipment were used to apply the coatings. Conventional air spray equipment was used to apply the IOZ coatings which require frequent agitation. Airless spray equipment was used to atomize some of the higher solids coatings to minimize the amount of required thinner. Figure 2-6 shows the arrangement of panel substrates during coating application. The center panel was used to measure wet film thickness, as shown in Figure 2-7.

2.2.5 Dry Film Thickness Measurement and Control

Shipyards usually apply PCP's as thin as possible to minimize coating-related problems in welding and torch cutting. Typical shipyard DFT's range from 0.5 to 1.5 mils. Thus, during preparation, panels with low, medium, and high DFT's (0.5 mil, 1.0 mil, and 1.5 mil) were established for each PCP candidate. This range of DFT's was also deemed appropriate by the paint manufacturers.

It was anticipated that precise application of PCP's to establish low, medium, and high DFT's would be difficult with manual spray equipment, so an excess number of test panels were produced for subsequent screening. The DFT of each coated panel was measured with a Mikrotest Model GM magnetic lift off gage after curing, as shown in Figure 2-8. Calibration of this gage was done in accordance with MTI Technical Procedure ARC-TP-1341, "Calibration Procedure for the Microtest IV Automatic Dry Film Coating Thickness Gage," prior to each use. This procedure is based on ASTM D1186-93, "Standard Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base." Panels having DFT's close to the target thicknesses were selected for the various laboratory and field tests.

The Mikrotest Model GM magnetic lift off gage measures thickness by using a spring calibrated to determine the force required to pull a permanent magnet from a ferrous base coated with a nonmagnetic film. The "GM" model is designed to measure DFT ranging from 0 to 4 mils. The instrument is placed directly on the coating surface to take a reading. The attractive force of the magnet to the substrate varies inversely with the thickness of the applied film. The spring tension required to overcome the attraction of the magnet to the substrate is shown on the instrument scale as the distance (in mils) between the magnet and the substrate.

Calibration of the Mikrotest lift off gage is conducted in an area free of stray magnetic fields, such as power lines, generators, or welding equipment. An uncoated steel panel substrate, which has been prepared in a fashion similar to the substrates on which the DFT's will be measured, is used for the calibration. Plastic shims in the expected thickness range to be measured (0-4 mils) are then placed against the steel substrate and measured with the lift off gage. If the gage readings differ from the representative thicknesses of the shims by amounts exceeding the allowable tolerances, then a calibration curve is plotted and used to correct the values indicated on the gage dial to obtain accurate thickness measurements of coating DFT's.

Once the spray-applied PCP had dried, a scribe mark was machined on the front face of each panel with an end mill as shown in Figure 2-9. This scribe mark (dimensions shown in Figure 2-1) was produced to simulate damage to the coating which exposes the carbon steel substrate, a probable situation which would be encountered during shipyard construction. End milling was chosen in lieu of blade cutting to ensure uniform, consistent conditions of substrate exposure during testing.

2.2.6 Overcoating the Adhesion Test Panels

Overcoated test panels needed to be tested for adhesion strength to assess 1) the compatibility of the PCP and the overcoat, and 2) the primer-to-substrate bond quality. Once each PCP had cured (taking approximately 2 weeks), each adhesion test panel was wiped with a clean lint-free cloth and painted with the manufacturer's recommended overcoat, as listed in Table 2-4. This deviation from the project plan (originally to apply two overcoats to each candidate primer) was approved by the project oversight committee, since paint suppliers rarely (if ever) specify other manufacturer's topcoats.

2.2.7 Adhesion Testing

Panels were tested for adhesion strength under Task 2 in accordance with ASTM D4541-85 using an Elcometer Adhesion Tester, Model 106 having a range of 0 - 1000 psi. For each test, the coating was scribed to the base metal around the dolly. A minimum of three measurements for adhesion strength were made on each panel. For each of the selected water-thinned PCP's, a set of three primed and overcoated panels (a total of 18) were tested to determine adhesive strength. As a comparison, similarly prepared panels primed with the two IOZ primers (a total of 6 panels) were also tested to determine adhesive strength. Each set of panels, prior to overcoating, had exhibited primer DFT's of about 0.5, 1.0, and 1.5 mils. A minimum of three measurements for adhesion strength were made on each panel, but as many as five measurements were made on some panels.

2.2.8 Preparation of Exposure Panels for Atmospheric Testing

Once the atmospheric exposure test panels were selected and scribed, they were mounted on the KTA test rack, as shown in Figures 2-10, 2-11, and 2-12. This rack was then boxed in protective packaging and shipped to the McDermott Shipyard in Amelia, LA to be placed atop a building for testing. Figures 2-13 and 2-14 show the location of the test rack after placement. Atmospheric exposure testing was initiated on June 17, 1996.

2.3 Task 3: Plasma Torch Cutting Tests

The goal of Task 3 was to conduct plasma torch cutting tests on 3/8" thick A36 steel panels which were coated with candidate primers and to assess the condition of the resultant cuts. Preparation of the cutting test panels had been done under Task 2 of the project. For this work, 24 panels (3/8" X 12" X 24") had been given an abrasive blast (SSPC SP10), and had been coated with the selected PCP's. Three panels had been prepared for each PCP to provide DFT's of about 0.5, 1.0, and 1.5 mils.

Cutting trials were conducted on an automated plasma torch cutting machine used in production operations at the McDermott Shipyard in Amelia, LA, as shown in Figure 2-15. Traverse speed for the cuts was set a 121 inches per minute. Severed panels were subsequently examined, and the surfaces of the kerf were rated (good, fair, poor) to characterize overall uniformity and condition, as shown in Figure 2-16.

2.4 Task 4: Welding Tests

The goal of Task 4 was to conduct fillet weld tests and to assess quality and condition of the fusion joints in accordance with MIL-STD-248D. Preparation of the weld test panels, which was completed under Task 2, was similar to that used to prepare panels for cutting tests in Task 3. For this work, 48 ASTM A36 steel panels (3/8" X 4" X 20") had been abrasive blasted (SSPC SP10) and coated with selected PCP's. For each PCP, three pairs of panels had been coated to provide three sets of web-and-flange assemblies having matching DFT's of about 0.5, 1.0, and 1.5 mils.

2.4.1 Production of Fillet-Welded Joints

Welding trials were conducted with a Lincoln twin-arc welding machine used in production operations at the McDermott Shipyard in Amelia, LA. This equipment allowed simultaneous welding of both fillets to minimize thermal distortion during post weld cooling. Matching panels were tack welded in order to fixture the web-to-flangeconfigurations and to abut these assemblies in a linear, end-to-end arrangement for continuous welding, as shown in Figure 2-17. Primer was not removed, cleaned, or otherwise treated prior to fillet welding at a linear speed of 10 inches per minute. After welding, each web-and-flange assembly was removed by flame cutting through the abutments. Each assembly was then flame cut into three sections about 5 - 7 inches in length to facilitate subsequent destructive testing (weld fracture and examination).

2.4.2 Bend Testing

To examine the interior region of the fusion zone, one of the fillet welds was removed from a section using an Arc-Air process (air carbon arc gouging). The opposite, adjacent weld was then broken by bending the flange to reveal the internal material structure and integrity at the fracture surface.

2.5 Task 5: Atmospheric Exposure Testing of Panels

Atmospheric exposure testing of the panels was conducted using ASTM D1014-83, "Standard Test Method for Conducting Exterior Exposure Tests of Paints on Steel," as a reference. This method covers the determination of the relative service of exterior coatings and other materials of similar purpose when applied to steel surfaces exposed out-of-doors.

2.5.1 Geographic Location and Configuration of Panels

The goal of Task 5 was to evaluate the relative performance of the selected PCP coatings over a 12-month period while being exposed to the atmosphere in a shipyard environment. For this work, twenty-four carefully prepared panels (8 PCP's X 3 DFT's) were mounted on a KTA test rack and positioned for a southerly exposure in a safe location at the top of a building in the McDermott Shipyard in Amelia, LA. Exposure testing was initiated on June 17, 1996. Periodic 3-month inspections of the panels were conducted thereafter, and their condition was assessed in accordance with ASTM D610-85 (scale of 0 to 10, where 10 is best). Actual inspection dates were September 17, 1996, December 17, 1996, March 17, 1997, and June 23, 1997, when the panels were removed from test and shipped to McDermott Technology, Inc. in Alliance, OH for final assessment.

2.5.2 Weather Records

Climatological observation records for the Amelia, LA region (Morgan City, LA) were procured for the duration of atmospheric exposure testing from the National Climatic Data Center in Asheville, NC. This information is documented and presented in Appendix 2-3

2.5.3 Inspection Methodology

Assessment of the atmospheric exposure test panels was conducted using ASTM D610-85, "Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces." This test method covers the evaluation of the degree of rusting on painted steel surfaces using visual standards. These visual standards were developed in cooperation with the Steel Structures Painting Council (SSPC) to further standardization of methods. The amount of rusting beneath or through a coating is a significant factor in determining whether a coating system should be repaired or replaced. This test method provided a standardized means for quantifying the amount of rust present on the panels during each 3- month inspection.

3.0 RESULTS AND DISCUSSION

3.1 Adhesion Test Results

Laboratory adhesion testing of panels which were prepared under Task 2 was conducted in accordance with ASTM D4541-85, "Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," using a calibrated Elcometer Adhesion Tester, Model 106 (MTI No. 0900820) having a range of 0 - 1000 psi.

For each of the six selected water-thinned PCP's, a set of three primed and overcoated panels (a total of 18) were tested to determine adhesive strength. For comparison, similarly prepared panels primed with International Zinc WB14A and Nippon Nippe Ceramo (a total of 6) were also tested to determine adhesive strength. Each set of panels, prior to overcoating, had exhibited primer DFT's of about 0.5, 1.0, and 1.5 mils.

A minimum of three measurements for adhesion strength were made on each panel, but as many as five measurements were made on some panels. Results of adhesion tests are summarized in Table 3-1. The tests showed that most of the coatings exhibited good adhesion, with strengths greater than 1000 psi.

3.2 Plasma Torch Cutting Test Results

Plasma torch cutting trials were conducted with an automated system used in production operations at the McDermott Shipyard in Amelia, LA. Traverse speed for the cuts was set at 121 inches per minute. Severed panels were subsequently examined, and the surfaces of the kerf were rated (good, fair, poor) to characterize overall uniformity and condition, as shown in Figure 3-1. Cuts of all panels were found to be good, and results (with comments) are summarized in Table 3-2. Photographs of additional cut panels are presented in Appendix 3-1.

3.3 Fillet Welding Test Results

After welding, the web-and-flange assemblies were removed by flame cutting through abutments. Each assembly was then flame cut into three sections about 5-7 inches in length to facilitate subsequent destructive testing (weld fracture and examination). Significant linear surface porosity was observed along the fusion centerline in most of the fillet welds, as shown in Figures 3-2 and 3-3. Photographs showing the test results of all other panels are presented in Appendix 3-2. Table 3-3 summarizes the results of the fillet weld testing and shows that welds for all web-and-flange assemblies coated with water-thinned primers failed minimum acceptance criteria. These results indicate that under these specific conditions, the PCP's may have to be removed to produce acceptable weld joints. While it was not within the established workscope of this project, it is recommended that additional testing be conducted to identify alternative welding parameters for making acceptable welds on panels with these coatings.

3.4 Atmospheric Exposure Test Results

Atmospheric exposure testing of the selected 24 panels was initiated on June 17, 1996 at the McDermott Shipyard in Amelia, LA. Interim periodic inspections of the panels were conducted every three months (on September 17, 1996, December 17, 1996, and March 17, 1997) with visual assessment per ASTM D610-85. Results of these inspections are presented in Tables 3-4, 3-5, and 3-6. Testing of the panels was terminated, as planned, on June 23, 1997 following 12 months of continuous exposure. The panels were removed from the rooftop in the shipyard, carefully packaged and shipped to McDermott Technology, Inc. in Alliance, OH for the final assessment to complete Task 5 of the project.

Final visual inspection of the panels was conducted at McDermott Technology on July 9, 1997. Results of the inspection, which are summarized in Table 3-7, show that half the panels were still rated above 6. Fourteen of the eighteen panels which were coated with water-thinned preconstruction primers were rated from 1 - 7, and of these, the lowest ratings generally correlated with DFT's of about 0.5 mil. Panels rated above 7, all of which had a nominal DFT of 1.0 mil or greater, were coated with either Amercoat 3207, Devran 720, or Hemudur 18580. Panels coated with solvent-borne Nippe Ceramo or International Zinc WB14A were rated at 7 or 9, except for one Nippe Ceramo-coated panel (rated 1) having a DFT of 0.5 mil. Results of the final visual inspection are presented in Table 3-7. Photographs showing the surface appearance of each panel after 12 months of exposure testing are presented in Appendix 3-3.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the testing, analysis, and investigation conducted in this project, the following conclusions and recommendations have been established:

- Results of laboratory adhesion testing of panels showed that the PCP's were compatible with the manufacturer's recommended topcoats and that most of the coatings exhibited good adhesion, with strengths greater than 1000 psi.

- Cuts of PCP-coated A36 steel panels which were severed by plasma torch, were rated as good (on a basis of good, fair, poor).

- Results of fillet welding trials, conducted using the selected set of parameters, revealed the presence of significant linear porosity along the fusion centerline in most of the welds. It is recommended that additional testing be conducted to identify alternative welding parameters to make acceptable welds on panels with these PCP coatings.

- Results of atmospheric exposure testing showed that selected water-thinned PCP's provide good corrosion protection for A36 steel for up to 12 months, with performance comparable to the two solvent-borne IOZ primers that were concurrently tested.

- All water-thinned PCP panels rated above 7 (including Amercoat 3207, Devran 720, and Hemurdur 18580) had nominal DFT's of about 1.0 mil or greater.

- Poorest performance of all primers tested generally correlated with applied in DFT's of about 0.5 mil.

5.0 REFERENCES

1. Keane, J.D., Ed., Good Painting Practice, Vol.1, Steel Structures Painting Council (SSPC), Pittsburgh, PA, 1993.

2. Hare, C.H., Protective Coatings: Fundamentals of Chemistry and Composition, SSPC 94-17, Technology Publishing Co., Pittsburgh, PA, 1994.

3. Crewdson, M.J., and Brennan, P., "Outdoor Weathering: Basic Exposure Procedures," Journal of Protective Coatings & Linings (JCPL), Vol.12, No.9, pp.17-25, September 1995.

4. Weldon, D.G., "The Effect of Oil, Grease, and Salts on Coating Performance," JPCL, June 1987.

5. "Evaluating Coatings for Environmental Compliance," SSPC 94-14, June 1994.

6. Roobol, N.R., "Industrial Painting: Principles and Practice," First Edition, 1991.

7. MacDowell, L.G., "Testing VOC - Compliant Coating Systems at Kennedy Space Center," Materials Performance, July 1993.

8. Metals Handbook, 9th Ed., Vol.5, "Surface Cleaning, Finishing, and Coating," ASM International, Materials Park, OH 1989.

9. Selected Notes, Hempel Coatings, TRB Section IV-3, "Shopprimer's Calculation of Consumption as a Function of Surface Configuration (Increase in Area),"TRB Section IV-8, "Abrasive Blasting, Anchor Pattern," Hempel Coatings (USA), Inc., Houston,TX.

10. Brevoort, G.H., "Abrasive Blasting and Salt Contamination: A Case History," JPCL, May 1988.

11. Johnson, W.C., "Corrosion Failure from Water-Soluble Contaminants on Abrasives," JPCL, September 1990.

12. Morgan, R.E., "Zero VOC Coating Technology - Innovative Solutions for Old Problems," Coatings & Linings, June 1996.

13. TIP-10, "Waterborne Coatings," JPCL, Pittsburgh, PA.

14. NSRP 0451, "Evaluation of Coatings Applied on Less Than Ideal Surfaces," September 1995.

15. TIP-32, "Marine and Off-Shore Structures: Cleaning and Painting," JPCL, Pittsburgh, PA.

16. Kelly, J., "Preconstruction Primers for Improved Shipyard Efficiency," Paper Presented at the 1996 Ship Production Symposium, Society of Naval Architects and Marine Engineers, La Jolla, CA, February 1996.

17. Taylor, R.D., Cornstubble, D.R., and Kosusko, M., "Evaluation of Innovative Low-Volatile Organic Compound (VOC) Industrial Maintenance (IM) Coatings," presented at the 16th AESF/EPA Conference on Pollution Prevention & Control for the Surface Finishing Industry, Orlando, FL, February 1995.

18. Reisch, M.S., "Paints & Coatings," C&EN, September 1995.

19. Pawel, S.J., "Evaluating Coating Systems for Long-Term Immersion Service," Materials Processing, October 1995.

20. Burgess, R.A., and Morrison, M.M., "Uncover Mistakes via Coating Failure Analysis," Chemical Engineering Progress, September 1995.

21. "Reducing VOC's at Kodak," Products Finishing, August 1995.

22. Finch, D., "In-Shop Painting of Structural Steel," Sherwin-Williams Company, 1995.

23. Woods, R.J., and Busby, D.C., "Cost-Effective Coating with Supercritical Fluid Technology," Materials Processing, November 1995.

24. Mohn, W.R., Turner, D.L., Pressley, T.S., and Dilling, M.J., "Study of Improved Methods for Painting and Preservation - FY 1995," Babcock & Wilcox Company, RDD:95:14420-700-000:01, March 1995.

TABLES AND FIGURES

TABLE 2-1

Shipyards Contacted
Regarding Water-Thinned
Preconstruction Primers

SHIPYARD	CONTACT	TELEPHONE	CURRENT PCP	COMMENTS
Atlantic Marine	Steve Cogswell	(904) 270-1950	IOZ	Currently using IOZ preconstruction primers.
Avondale	Earnie Miguez	(504) 436-5559	WB Epoxy, Acrylic-Epoxy	Have not used IOZ PCPs in several years. Prefers Interguard 292 WB
Ingalls	Kay Freeman	(601) 935-3919	IOZ	Production line not set up for WB PCPs
Marinet Marine	Mike Benisch	(715) 735-9341	WB Acrylic-Epoxy	Using Devran 720. Accepted by USCG.
McDermott	Roland Benoit	(504) 631-7741	WB IOZ	Have experimented favorably with Interguard 292 WB. Currently using International Zinc WB14A PCP.
NASSCO	Judy Blakey	(619) 544-8443	IOZ	Have implemented Nippe Ceramo IOZ and VOC collection system.
Newport News	Walt Fortenberry	(804) 380-2567	IOZ	Not using waterborne PCPs. Have implemented Nippe Ceramo IOZ.

TABLE 2-2

Companies Contacted Regarding Water-Thinned
Preconstruction Primers
With No Metal Pigments

COMPANY	LOCATION	CONTACT	TELEPHONE	COMMENTS
Adv. Polymer Sci.	Avon, OH	Bryan Austin	216-937-6218	Does not produce preconstruction primers
Ameron	Brea, CA	Harlan Klein	714-529-1951	Recommended Amercoat 3207
Carboline	St. Louis, MO	Larry McDonald	314-644-1000	Recommended Carboline 8101
Courtaulds	Houston, TX	Jim Denny	713-684-1282	Recommended Intergard 292 WB
Devoe	New Berlin, WI	John Tanner	410-788-0431	Recommended Devran 720
Dupont	Wilmington, DE	various	800-298-7668	Does not produce marine PCPs
Glidden	Harahan, LA	Earl Herbez	504-737-6550	Not suitable for immersion service
Hempel	Houston, TX	Mike Bentkjaer	713-672-0616	Recommended Hemudur 18580
International Zinc	New York, NY	Greg Falberg	212-465-9218	Recommended WB14A inorganic zinc
Jotun Valspar	Baltimore, MD	Derick Hayman	800-638-7756	Recommended Sovaprime 13R96
Porter	Louisville, KY	John Lanning	502-588-9200	Referred us to parent company, Courtaulds
PPG	Pittsburgh, PA	Dee Rice	800-441-9695	Not recommended for immersion service
Sherwin Williams	Cleveland, OH	Mark Perrings	216-341-9986	Recommended Kem Aqua 70P
Sigma	Houston, TX	Dan Robbins	713-672-1175	Recommended Sigma 1K WB
Tnemec	Kansas City, MO	Mark Bollinger	816-483-3400	Does not produce preconstruction primers
Wasser	Kent, WA	Kevin Grillo	206-850-2969	Does not produce preconstruction primers
Xymax	Marietta, GA	Bud Gundaker	800-332-3136	Does not produce preconstruction primers

TABLE 2-3

Preconstruction Primers
Selected for Laboratory
and Field Testing

Manufacturer	Product Designation	Product Description	VOC lb/gal	Volume Solids %	Parts	500 gal $/gallon	Coverage sq. ft./gal.	Cost $/sq. ft.	Touch Dry at 70 F	Shipyard Users	Comments
Ameron	Amercoat 3207	Waterborne Acrylic Epoxy off white, gray, oxide red	1.9	39	2	25.00	625	0.04	15 minutes	Avondale	Somewhat sticky until cured
Carboline	Carboline 8101	Waterborne Acrylic many colors	1.1	39	1	39.13	417	0.094	30 minutes	none known	Has been tested at Avondale
Devoe	Devran 720	Water based Acrylic Epoxy red	0.72	43	2	30.50	688	0.044	15 minutes (3 min w PH)	Marinet	Works well on auto. equipt
Hempel	Hemudur 18580	WB Epoxy + amine adduct red	1.3	43	2	66.50	526	0.126	3 min w PH	various	Used in Belgium and England
International Courtaulds	Intergard 292WB	Waterborne Epoxy red	2.25	31	2	45.88	497	0.092	50 minutes	McDermott Avondale	Dries quickly
Joten Valspar	Sovaprime 13R96	Water Reducable Epoxy Primer, red	1.07	46	2	23.00	738	0.031	10 minutes	Avondale Newport?	Seeking MIL-P-23236 approval
Nippon	Nippe Ceramo SW NQA 993/997	Inorganic Zinc PCP gray	5.4	25	2	72.33	681	0.106	3 min w PH	NASSCO Newport	Reference coating
International Zinc Corp.	WB14A	Water Based Inorganic Zinc PCP gray	0	65	2	22.00	1000	0.022	3 min w PH	McDermott Atlantic Trinity	Reference coating Dries quickly on automatic equipment, economical

TABLE 2-4

NSRP 3-95-3

ADHESION TESTING

(RDD Project 43489)

No.	Preconstruction Primer	Overcoat (4 mil DFT)
1	Amercoat 3207	Amercoat 385
2	Carboline 8101	Carboline 890
3	Devran 720	Bar Rust 235
4	Hemudur 18580	Hemudur 4515
5	Intergard 292WB	Intergard KB
6	Sovaprime 13R96	Sovapon 513W27

TABLE 3-1

ADHESION TESTS
(ASTM D4541-85)*

Panel Mark	Primer	Top Coat	Adhesion Measurements (PSI)					Location of Failure
			#1	#2	#3	#4	#5	
N5	Amercoat 3207	Amercoat 385	>1000	>1000	>1000	--	--	None
N4	Amercoat 3207	Amercoat 385	>1000	>1000	>1000	--	--	None
N24	Amercoat 3207	Amercoat 385	>1000	>1000	>1000	--	--	None
N33	Carboline 8101	Carboline 890	650	350	650	750	650	Substrate
N38	Carboline 8101	Carboline 890	500	350	600	650	725	Substrate
N35	Carboline 8101	Carboline 890	600	575	550	--	--	Substrate
N171	Devran 720	Bar Rust 235	>1000	625	>1000	--	--	Adhesive
N176	Devran 720	Bar Rust 235	>1000	>1000	>1000	--	--	None
N175	Devran 720	Bar Rust 235	>1000	>1000	>1000	--	--	None
N126	Hemudur 18580	Hemudur 4515	>1000	>1000	>1000	--	--	None
N129	Hemudur 18580	Hemudur 4515	>1000	>1000	>1000	--	--	None
N156	Hemudur 18580	Hemudur 4515	>1000	>1000	>1000	--	--	None
N76	Intergard 292 WB	Intergard KB	>1000	>1000	>1000	>1000	--	None
N81	Intergard 292 WB	Intergard KB	>1000	>1000	>1000	--	--	None

TABLE 3-1 (CONTINUED)

ADHESION TESTS
(ASTM D4541-85)*

Panel Mark	Primer	Top Coat	Adhesion Measurements (PSI)					Location of Failure
			#1	#2	#3	#4	#5	
N86	Intergard 292 WB	Intergard KB	>750	>1000	>1000	875	1000	Between Coats
N152	Sovaprime 13R96	Sovapon 513 W27	>1000	>1000	>1000	--	--	None
N89	Sovaprime 13R96	Sovapon 513 W27	>1000	>1000	>1000	--	--	None
N163	Sovaprime 13R96	Sovapon 513 W27	>1000	>1000	>1000	--	--	None
N132	Int. Zinc. WB14A	Bar Rust 235	>1000	575	575	775	--	Adhesive
N135	Int. Zinc. WB14A	Bar Rust 235	750	>1000	>1000	--	--	Adhesive
N56	Int. Zinc. WB14A	Bar Rust 235	900	950	550	>1000	>1000	Adhesive
N164	Nippe Ceramo	Bar Rust 235	>1000	>1000	850	--	--	Adhesive
N47	Nippe Ceramo	Bar Rust 235	>1000	>1000	>1000	--	--	Adhesive
N50	Nippe Ceramo	Bar Rust 235	>1000	>1000	950	--	--	Adhesive

*Coating system was scribed to base metal around dolly for all tests.

TABLE 3-2

MCDERMOTT SHIPYARD

PLASMA CUT TESTS * - 3/8" A36 PLATE

Panel Mark	Primer	DFT (Mils)	Cut Results (Good, Fair, Poor)	Comments
C1	Amercoat 3207	0.7	Good	less fumes than IOZ primer
C2	Amercoat 3207	1.1	Good	less fumes than IOZ primer
C3	Amercoat 3207	1.6	Good	less fumes than IOZ primer
C7	Carboline 8101	0.6	Good	less fumes than IOZ primer
C8	Carboline 8101	1.1	Good	less fumes than IOZ primer
C9	Carboline 8101	1.5	Good	less fumes than IOZ primer
C13	Nippe Ceramo	0.5	Good	
C14	Nippe Ceramo	1.1	Good	
C15	Nippe Ceramo	2.0	Good	
C19	Intl. Zinc WB14A	0.6	Good	
C20	Intl. Zinc. WB14A	1.0	Good	
C21	Intl. Zinc WB14A	1.5	Good	
C25	Intergard 292 WB	0.8	Good	less fumes than IOZ primer
C26	Intergard 292 WB	1.0	Good	less fumes than IOZ primer
C27	Intergard 292 WB	1.8	Good	less fumes than IOZ primer

Ref. Appendix 3-1

TABLE 3-2 (CONTINUED)

MCDERMOTT SHIPYARD

PLASMA CUT TESTS* - 3/8" A36 PLATE

Panel Mark	Primer	DFT (Mils)	Cut Results (Good, Fair, Poor)	Comments
C31	Sovaprime 13R96	0.4	Good	less fumes than IOZ primer
C32	Sovaprime 13R96	0.9	Good	less fumes than IOZ primer
C33	Sovaprime 13R96	1.5	Good	less fumes than IOZ primer
C37	Hemudur 18580	0.5	Good	less fumes than IOZ primer
C38	Hemudur 18580	0.9	Good	less fumes than IOZ primer
C39	Hemudur 18580	1.6	Good	less fumes than IOZ primer
C43	Devran 720	0.7	Good	less fumes than IOZ primer
C44	Devran 720	0.8	Good	less fumes than IOZ primer
C45	Devran 720	1.7	Good	less fumes than IOZ primer

* Torch travel rate was 121 inches/minute.

Ref. Appendix 3-1

TABLE 3-3

MCDERMOTT SHIPYARD
WELD TESTS

(MIL-STD-248D-10 MAR. 1989)

Mark	Primer	DFT (Mils)	Pore Size (32nd of inch)	Total Pores	Pass/Fail
W4	Amercoat 3207	0.8(1)/0.5(2)	1-3	46 in 15"	Fail
W5	Amercoat 3207	1.1/1.1	2-4	10 in 7"	Fail
W6	Amercoat 3207	1.5/1.5	1-8	32 in 15"	Fail
W10	Carboline 8101	0.5/0.5	1-6	11 in 9"	Fail
W11	Carboline 8101	1.0/0.9	1-5	50 in 13"	Fail
W12	Carboline 8101	1.4/1.4	2-8	61 in 15"	Fail
W16	Nippe Ceramo	0.5/0.5	0-1	3 in 15"	Pass
W17	Nippe Ceramo	1.0/1.0	1-3	97 in 15"	Fail
W18	Nippe Ceramo	1.5/1.5	1-4	12 in 6"	Fail
W22	Intl. Zinc WB14A	0.5/0.6	0-1	3 in 6"	Pass
W23	Intl. Zinc WB14A	1.0/1.1	2-5	38 in 15"	Fail
W24	Intl. Zinc WB14A	1.5/1.5	2-5	15 in 3"	Fail
W28	Intergard 292 WB	0.7/0.8	1-6	45 in 15"	Fail
W29	Intergard 292 WB	1.0/1.1	1-8	46 in 14"	Fail

Ref. Appendix 3-2

TABLE 3-3 (CONTINUED)

MCDERMOTT SHIPYARD
WELD TESTS

(MIL-STD-248D - 10 MAR. 1989)

Mark	Primer	DFT (Mils)	Pore Size (32nd of inch)	Total Pores	Pass/Fail
W30	Intergard 292 WB	1.6/1.5	2-8	40 in 14"	Fail
W34	Sovaprime 13R96	0.5/0.5	1-8	9 in 13"	Fail
W35	Sovaprime 13R96	1.2/1.1	1-5	48 in 15"	Fail
W36	Sovaprime 13R96	1.5/1.1	2-5	25 in 12"	Fail
W40	Hemudur 18580	0.5/0.5	2-6	25 in 11"	Fail
W41	Hemudur 18580	0.9/1.2	2-8	37 in 12"	Fail
W42	Hemudur 18580	1.5/1.4	1-6	42 in 15"	Fail
W46	Devran 720	0.9/0.5	1-5	53 in 14"	Fail
W47	Devran 720	1.1/1.2	2-3	25 in 14"	Fail
W48	Devran 720	1.4/1.2	2-4	35 in 12"	Fail

(1) DFT of Base Plate (2) DFT of Vertical Plate

Ref. Appendix 3-2

First 3-Month Inspection
Conducted September 17, 1996

TABLE 3-4

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 3 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N14	Amercoat 3207	0.5	10	
N8	Amercoat 3207	1.0	10	
N23	Amercoat 3207	1.5	10	
N30	Carboline 8101	0.5	9	heavy rusting in scribe
N27	Carboline 8101	0.9	9	heavy rusting in scribe
N148	Carboline 8101	1.4	10	heavy rusting in scribe
N169	Devran 720	0.5	9	
N168	Devran 720	0.9	10	
N173	Devran 720	1.7	10	
N125	Hemudur 18580	0.5	9	surface beginning to chalk
N119	Hemudur 18580	1.0	10	surface beginning to chalk
N157	Hemudur 18580	1.5	10	surface beginning to chalk
N82	Intergard 292 WB	0.7	9	scribe barely rusting
N75	Intergard 292 WB	1.1	10	scribe barely rusting
N83	Intergard 292 WB	1.5	10	scribe barely rusting

TABLE 3-4 (CONTINUED)

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 3 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N150	Sovaprime 13R96	0.5	7	
N95	Sovaprime 13R96	1.0	10	
N155	Sovaprime 13R96	1.4	10	
N133	Int. Zinc WB14A	0.5	10	white stains on surface
N66	Int. Zinc WB14A	1.0	10	
N55	Int. Zinc. WB14A	1.5	10	
N165	Nippe Ceramo	0.5	10	
N48	Nippe Ceramo	1.2	10	
N49	Nippe Ceramo	1.5	10	

Second 3-Month Inspection
Conducted December 17, 1996

TABLE 3-5

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 6 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N14	Amercoat 3207	0.5	8	White stains on surface
N8	Amercoat 3207	1.0	10	White stains on surface
N23	Amercoat 3207	1.5	10	White stains on surface
N30	Carboline 8101	0.5	6	Heavy rusting in scribe and at edges
N27	Carboline 8101	0.9	6	Heavy rusting in scribe and at edges
N148	Carboline 8101	1.4	7	Heavy rusting in scribe
N169	Devran 720	0.5	6	Heavy rusting in scribe and at edges
N168	Devran 720	0.9	7	Heavy rusting in scribe
N173	Devran 720	1.7	10	Rusting in scribe
N125	Hemudur 18580	0.5	3	Chalking with moderately severe rusting
N119	Hemudur 18580	1.0	8	Surface chalking
N157	Hemudur 18580	1.5	8	Surface chalking
N82	Intergard 292 WB	0.7	2	Severe rusting across surface
N75	Intergard 292 WB	1.1	3	Moderately severe rusting across surface

TABLE 3-5 (CONTINUED)

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 6 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N83	Intergard 292 WB	1.5	7	Heavy rusting in scribe and at edges
N150	Sovaprime 13R96	0.5	1	Very severe rusting across surface
N95	Sovaprime 13R96	1.0	5	Heavy rusting in scribe
N155	Sovaprime 13R96	1.4	6	Heavy rusting in scribe
N133	Int. Zinc WB14A	0.5	9	White stains across surface and edges rusting
N66	Int. Zinc WB14A	1.0	10	Light rusting in scribe
N55	Int. Zinc. WB14A	1.5	10	Very light rusting in scribe
N165	Nippe Ceramo	0.5	3	Rust "feathering out" from scribe
N48	Nippe Ceramo	1.2	10	Very light surface chalking
N49	Nippe Ceramo	1.5	10	Very light surface chalking

Third 3-Month Inspection
Conducted March 17, 1997

TABLE 3-6

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 9 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N14	Amercoat 3207	0.5	8	Heavy chalking on surface
N8	Amercoat 3207	1.0	9	Moderate chalking on surface
N23	Amercoat 3207	1.5	9	Light on surface
N30	Carboline 8101	0.5	6	Heavy rusting in scribe and at edges
N27	Carboline 8101	0.9	6	Heavy rusting in scribe and at edges
N148	Carboline 8101	1.4	7	Heavy rusting in scribe
N169	Devran 720	0.5	6	Heavy chalking, rusting in scribe
N168	Devran 720	0.9	6	Heavy chalking, rusting in scribe
N173	Devran 720	1.7	9	Light chalking, rusting in scribe
N125	Hemudur 18580	0.5	3	Chalking with moderately severe rusting
N119	Hemudur 18580	1.0	8	Moderate surface chalking
N157	Hemudur 18580	1.5	8	Surface chalking
N82	Intergard 292 WB	0.7	2	Heavy chalking, rusting in scribe
N75	Intergard 292 WB	1.1	2	Moderate chalking, rusting in scribe

TABLE 3-6 (CONTINUED)

MCDERMOTT SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 9 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N83	Intergard 292 WB	1.5	6	Light chalking, rusting in scribe
N150	Sovaprime 13R96	0.5	1	Very severe rusting across surface
N95	Sovaprime 13R96	1.0	5	Heavy chalking, rusting in scribe
N155	Sovaprime 13R96	1.4	5	Heavy chalking, rusting in scribe
N133	Int. Zinc WB14A	0.5	8	White stains across surface and edges rusting
N66	Int. Zinc WB14A	1.0	10	Light rusting in scribe
N55	Int. Zinc. WB14A	1.5	10	Very light rusting in scribe
N165	Nippe Ceramo	0.5	2	Heavy rust "feathering out" from scribe
N48	Nippe Ceramo	1.2	10	Very light chalking, rust in scribe
N49	Nippe Ceramo	1.5	10	Very light chalking, rust in scribe

TABLE 3-7

Fourth and Final 3-Month Inspection
Conducted July 9 1997
Testing Terminated on June 23, 1997

BOLLINGER SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 12 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N14	Amercoat 3207	0.5	7	Heavy chalking on surface
N8	Amercoat 3207	1.0	9	Moderate chalking on surface
N23	Amercoat 3207	1.5	9	Light chalking on surface
N30	Carboline 8101	0.5	5	Heavy rusting in scribe and at edges
N27	Carboline 8101	0.9	6	Heavy rusting in scribe and at edges
N148	Carboline 8101	1.4	7	Heavy rusting in scribe
N169	Devran 720	0.5	6	Light surface rust, rusting in scribe
N168	Devran 720	0.9	6	Surface chalking, rusting in scribe
N173	Devran 720	1.7	9	Surface chalking, rusting in scribe
N125	Hemudur 18580	0.5	2	Severe rusting across surface
N119	Hemudur 18580	1.0	7	Moderate surface chalking
N157	Hemudur 18580	1.5	8	Moderate surface chalking
N82	Intergard 292 WB	0.7	2	Heavy chalking, rusting in scribe
N75	Intergard 292 WB	1.1	2	Heavy chalking, rusting in scribe

Ref. Appendix 3-3

TABLE 3-7 (CONTINUED)

BOLLINGER SHIPYARD

ATMOSPHERIC PANEL INSPECTION - 12 MONTH EXPOSURE

Panel Mark	Primer	DFT (Mils)	ASTM D 610-85 0 to 10 (10 Best)	Comments
N83	Intergard 292 WB	1.5	6	Light chalking, rusting in scribe
N150	Sovaprime 13R96	0.5	1	Very severe rusting across surface
N95	Sovaprime 13R96	1.0	5	Heavy chalking, rusting in scribe
N155	Sovaprime 13R96	1.4	5	Heavy chalking, rusting in scribe
N133	Int. Zinc WB14A	0.5	7	White surface stains, scribe and edges rusting
N66	Int. Zinc WB14A	1.0	9	Light rusting in scribe
N55	Int. Zinc. WB14A	1.5	9	Very light rusting in scribe
N165	Nippe Ceramo	0.5	1	Light surface rust, heavy rusting in scribe
N48	Nippe Ceramo	1.2	9	Very light chalking, rust in scribe
N49	Nippe Ceramo	1.5	9	Very light chalking, rust in scribe

Ref Appendix 3-3

CALCULATION SHEET

PROJECT TITLE NSRP 3-95-3

PROJECT NO. 43489

SUBJECT TEST PANEL SCRIBE DETAILS

PAGE 1 OF 1

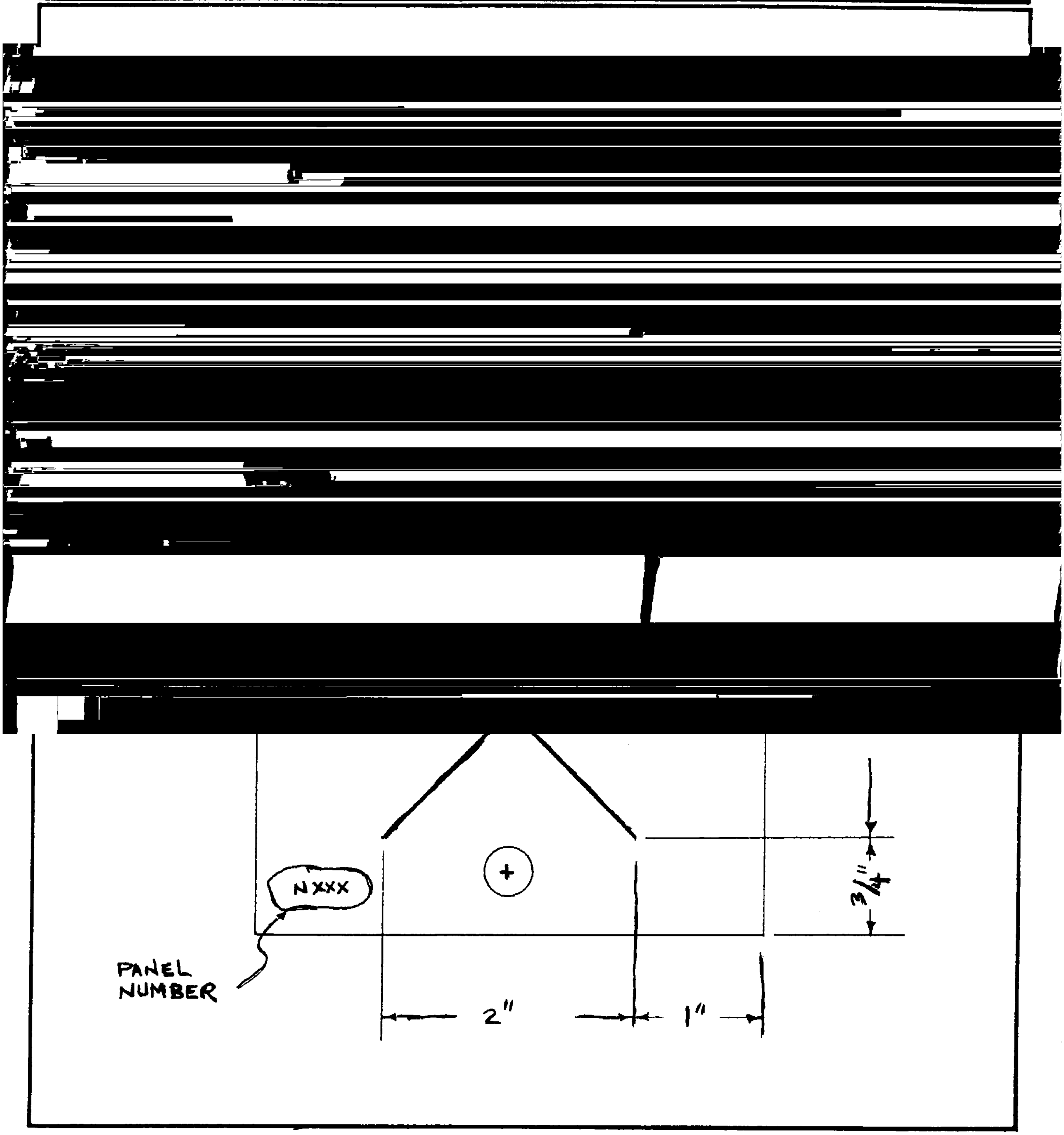


Figure 2-1 Atmospheric Exposure Test Panel Design.

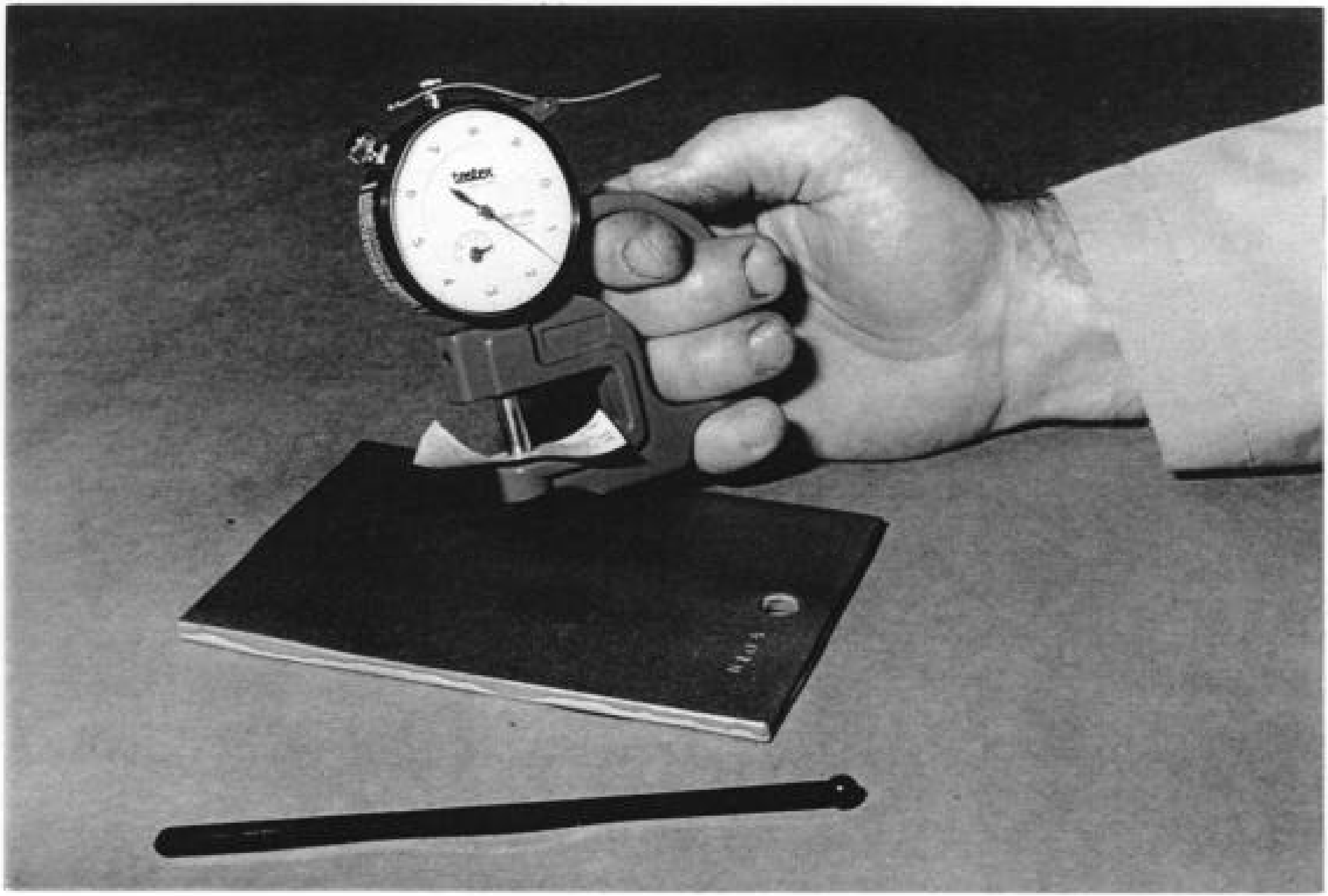


Figure 2-2 **Measuring the Panel Surface Profile With Testex Gage and Press-O-Film Replica Tape After Shot Blasting.**

Figure 2-3 **Vacu-Blast Equipment Used To Prepare all Test Panels Prior to Primer Application.**

Figure 2-4 **Blast Cleaning a Weld Test Panel With S70 Shot.**

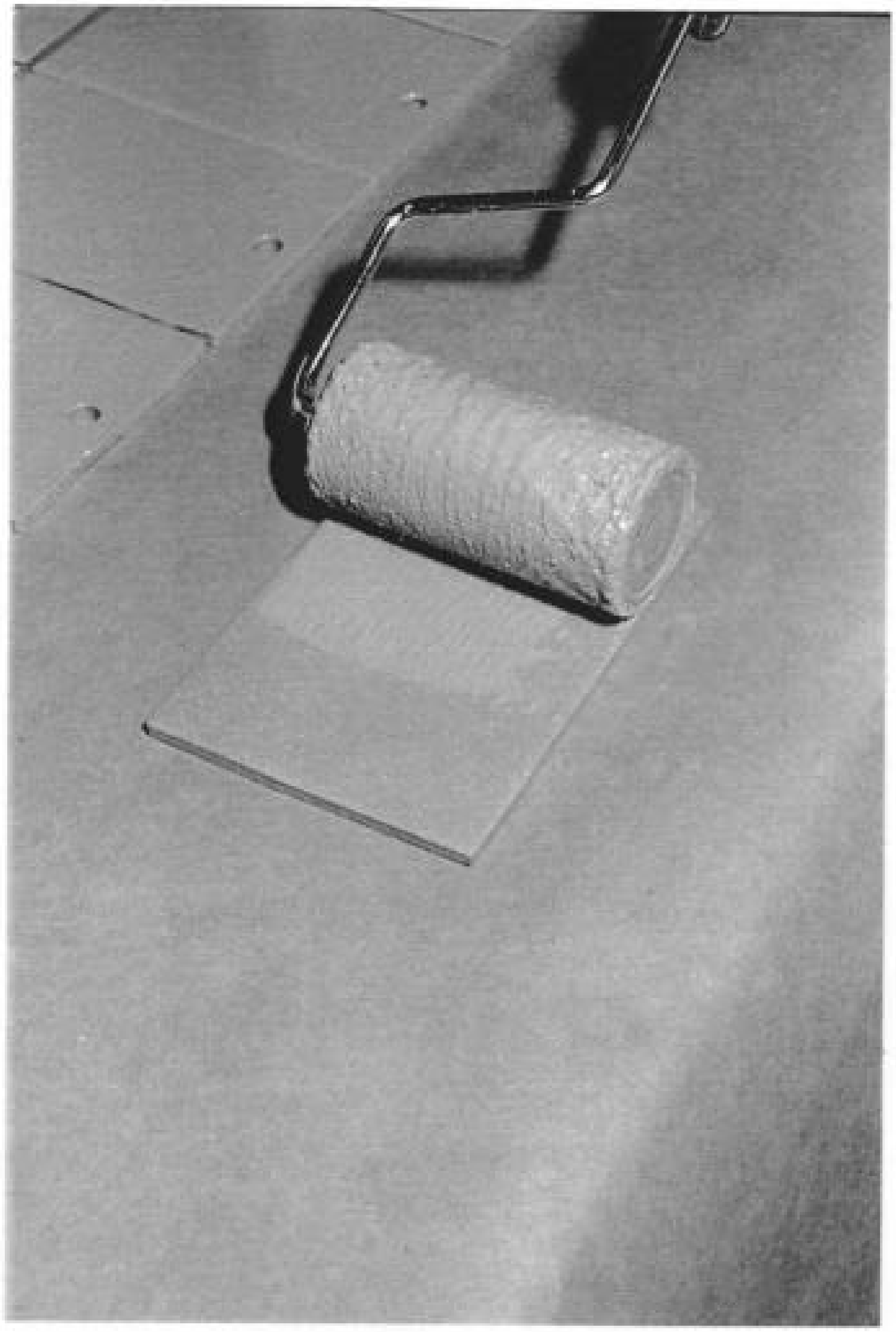


Figure 2-5 **Applying Bar Rust 235 to Back of an Atmospheric Test Panel.**

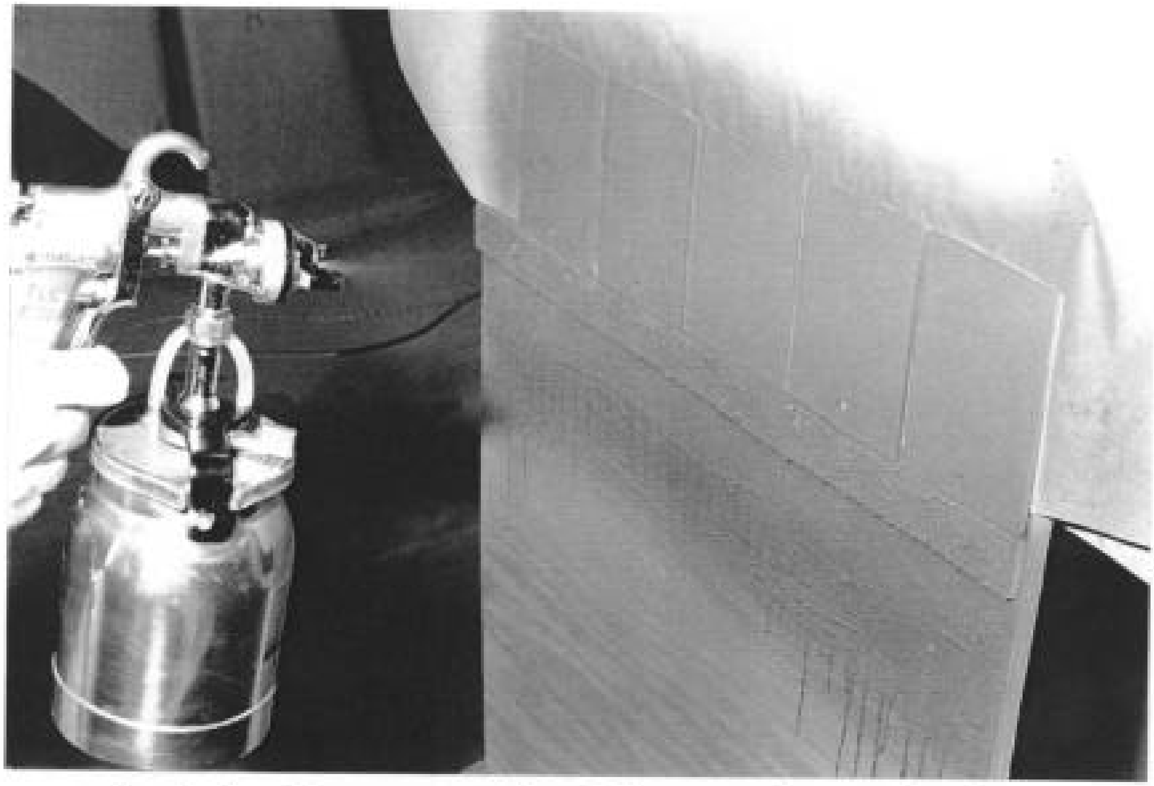


Figure 2-6 **Applying Preconstruction Primer to Atmospheric Exposure Test Panels. Only the Center Plate was Used to Check Wet Film Thickness.**

Figure 2-7 **Measuring Wet Film Thickness of the Dummy Panel Immediately After PCP Application.**

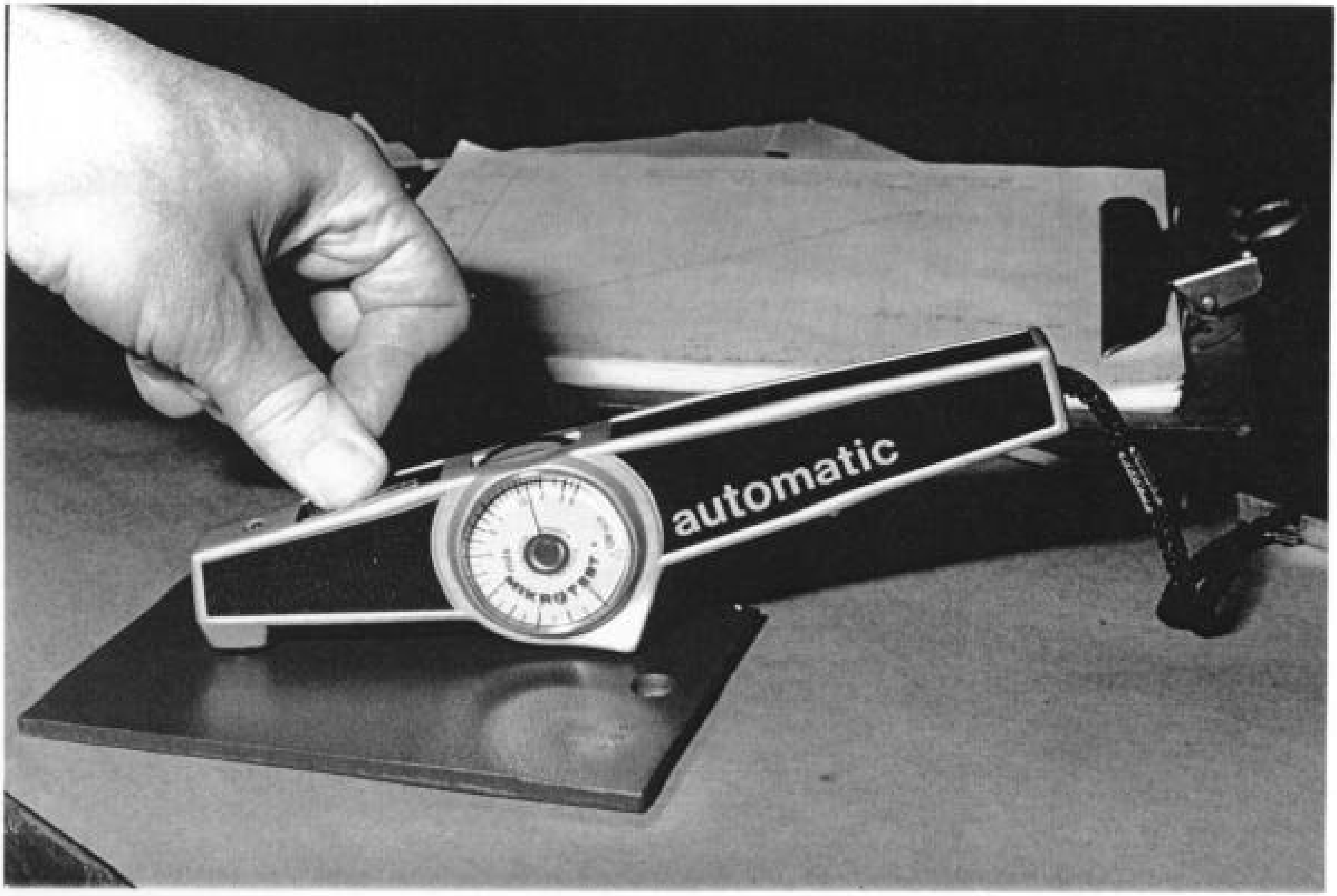


Figure 2-8 **Measuring Dry Film Thickness After Curing. A Low Range Magnetic Lift-Off Gage (Mikrotest Model GM) was Used.**

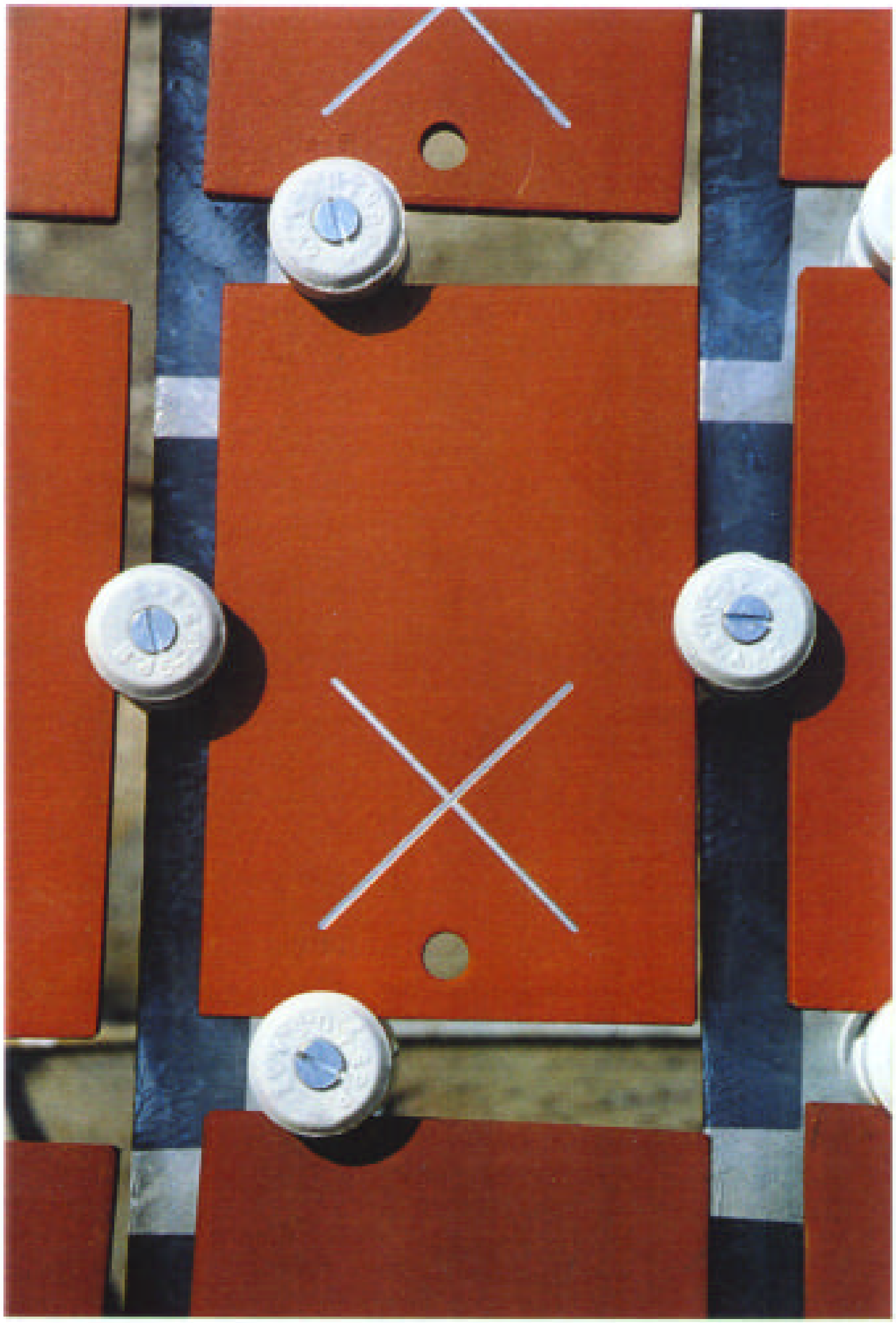


Figure 2-9 **Close-up of Test Panel N168 Prior to Shipyard Exposure.**

N14 Low DFT	N8 Amercoat 3207 Med. DFT	N23 High DFT	N30 Low DFT	N27 Carboline 8101 Med. DFT	N148 High DFT
N169 Low DFT	N168 Devran 720 Med. DFT	N173 High DFT	N125 Low DFT	N119 Hemdur 18580 Med. DFT	N157 High DFT
N82 Low DFT	N75 Intergard 292WB Med. DFT	N83 High DFT	N150 Low DFT	N95 Sovaprime 13R96 Med. DFT	N155 High DFT
N133 Low DFT	N66 Int. Zinc WB14A Med. DFT	N55 High DFT	N165 Low DFT	N48 Nippe Ceramo SW NQA Med. DFT	N49 High DFT

Figure 2-10 Test Panel Location on Shipyard Exposure Rack.

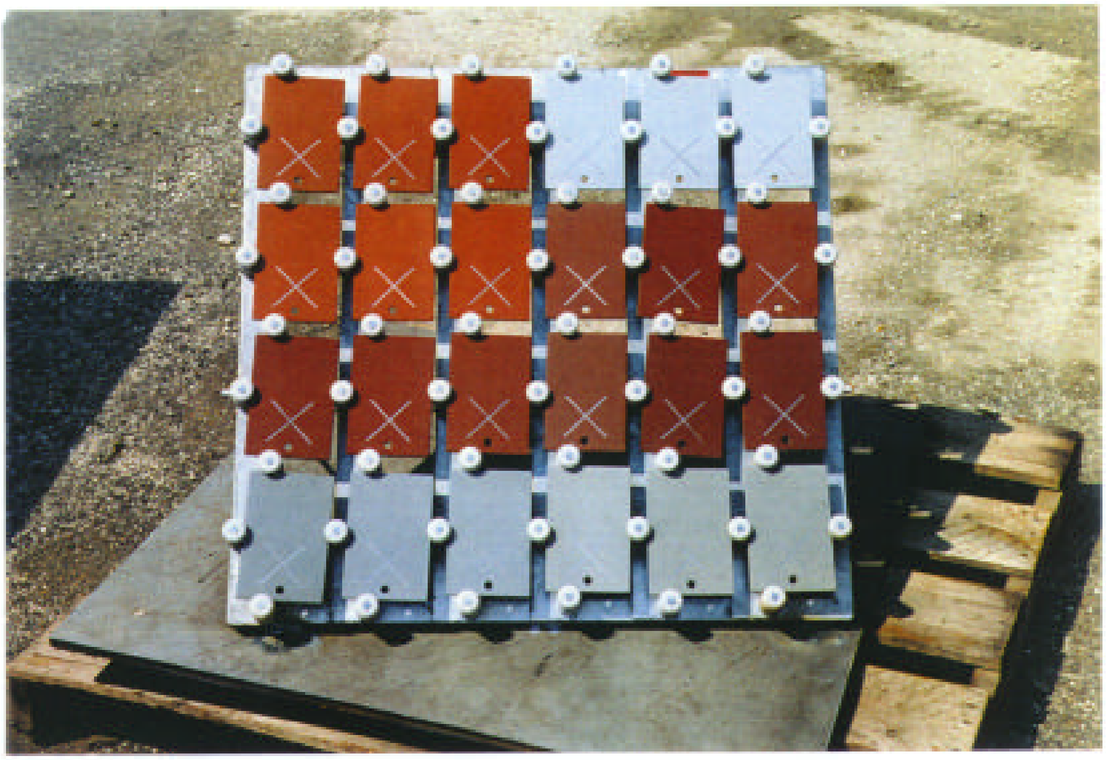


Figure 2-11 . **Atmospheric Exposure Test Rack Prior to Exposure at McDermott Shipyard.**

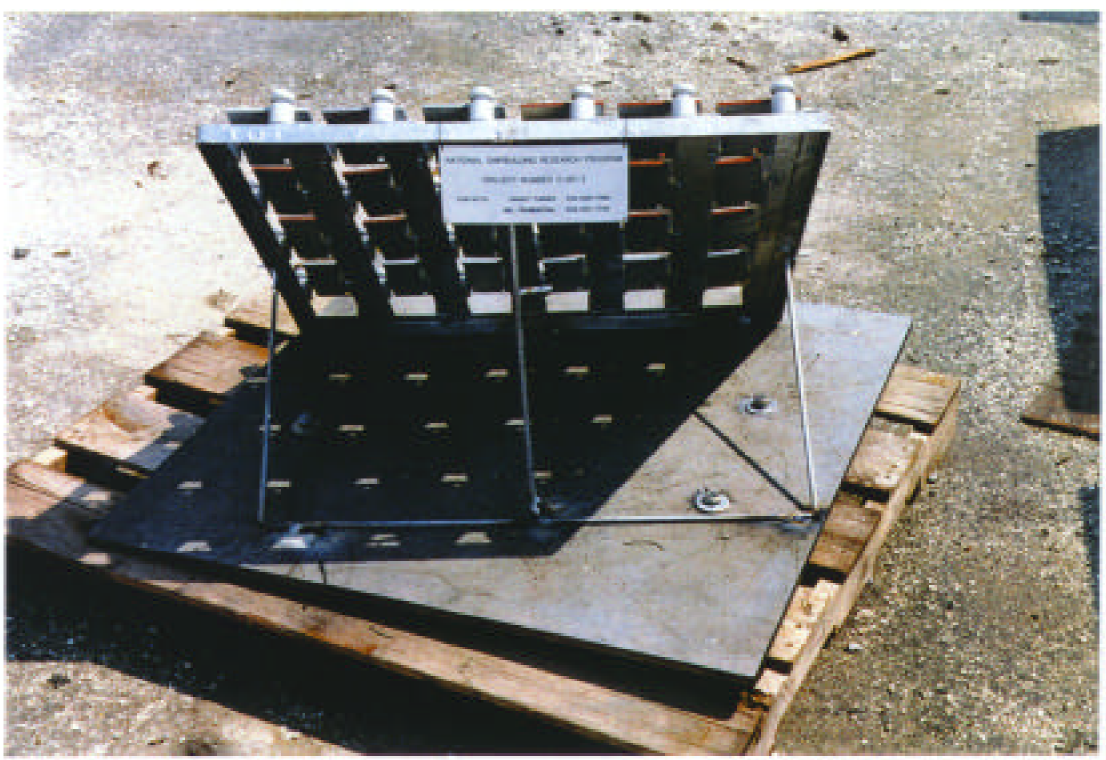


Figure 2-12 . **Back Side of Above Rack Prior to Exposure at McDermott Shipyard. Note Bolts for Attachment of Steel Base.**

Figure 2-13 . Location of Atmospheric Exposure Rack (Arrow) at McDermott Shipyard in Amelia, Louisiana.

Figure 2-14 . Close-up View of Above Test Rack Location. The Atmospheric Exposure Began on June 17, 1996.

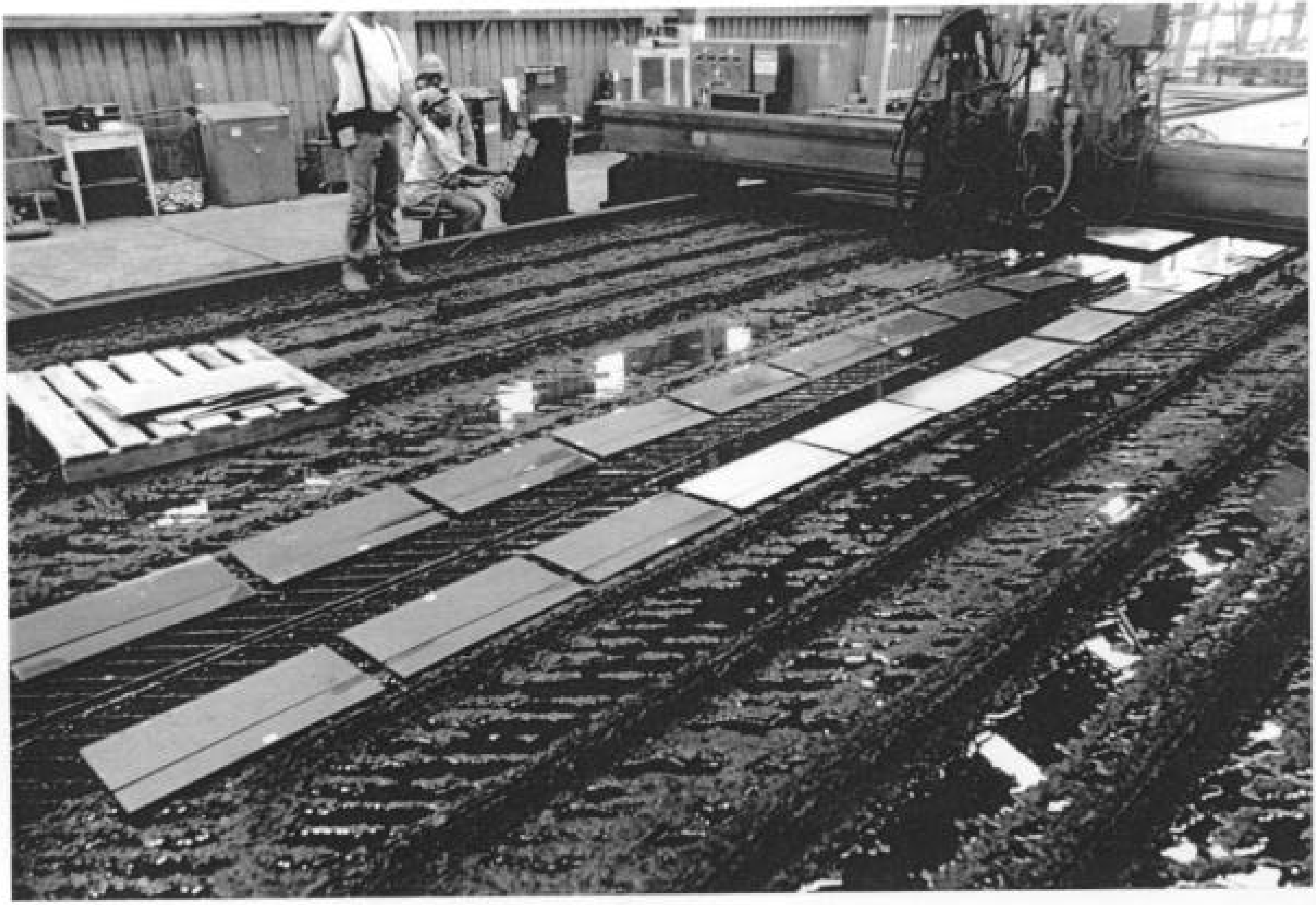


Figure 2-15 Photograph showing the automated plasma torch cutting system used for cutting primer-coated panels. This machine is used in production operations at the McDermott Shipyard in Amelia, LA.

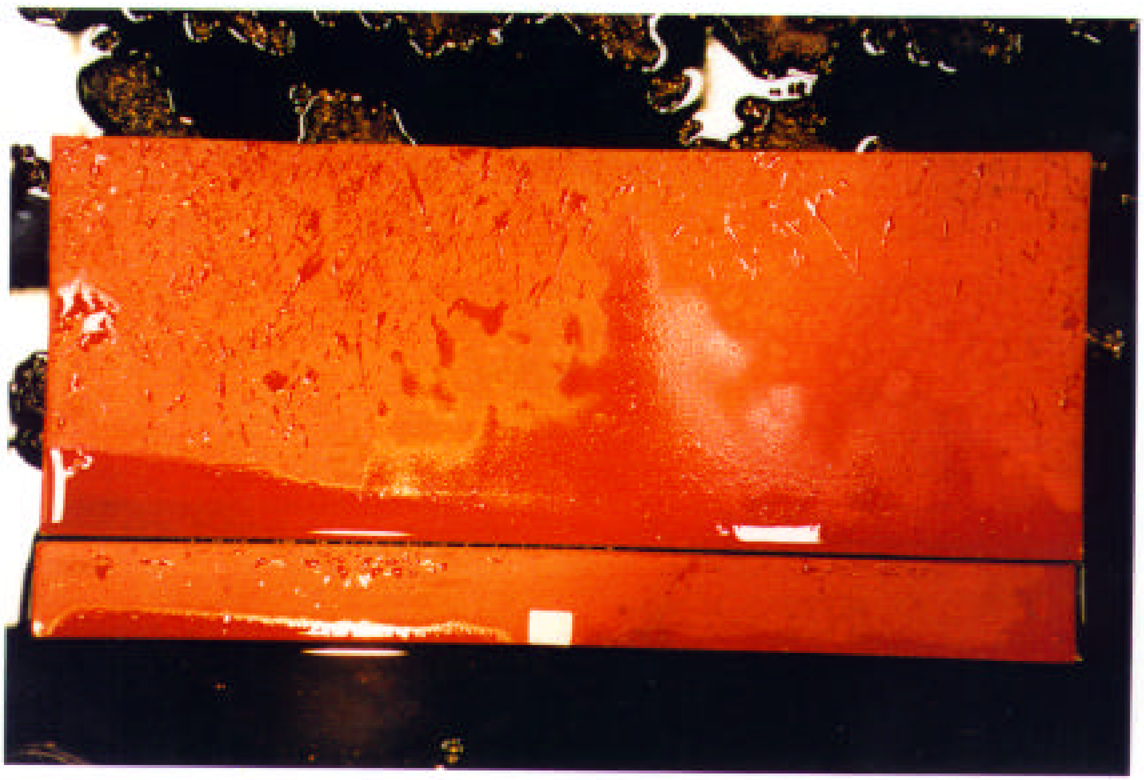


Figure 2-16 Photograph showing a primer-coated panel severed by the plasma cutting torch. Cuts of all panels were found to be good.

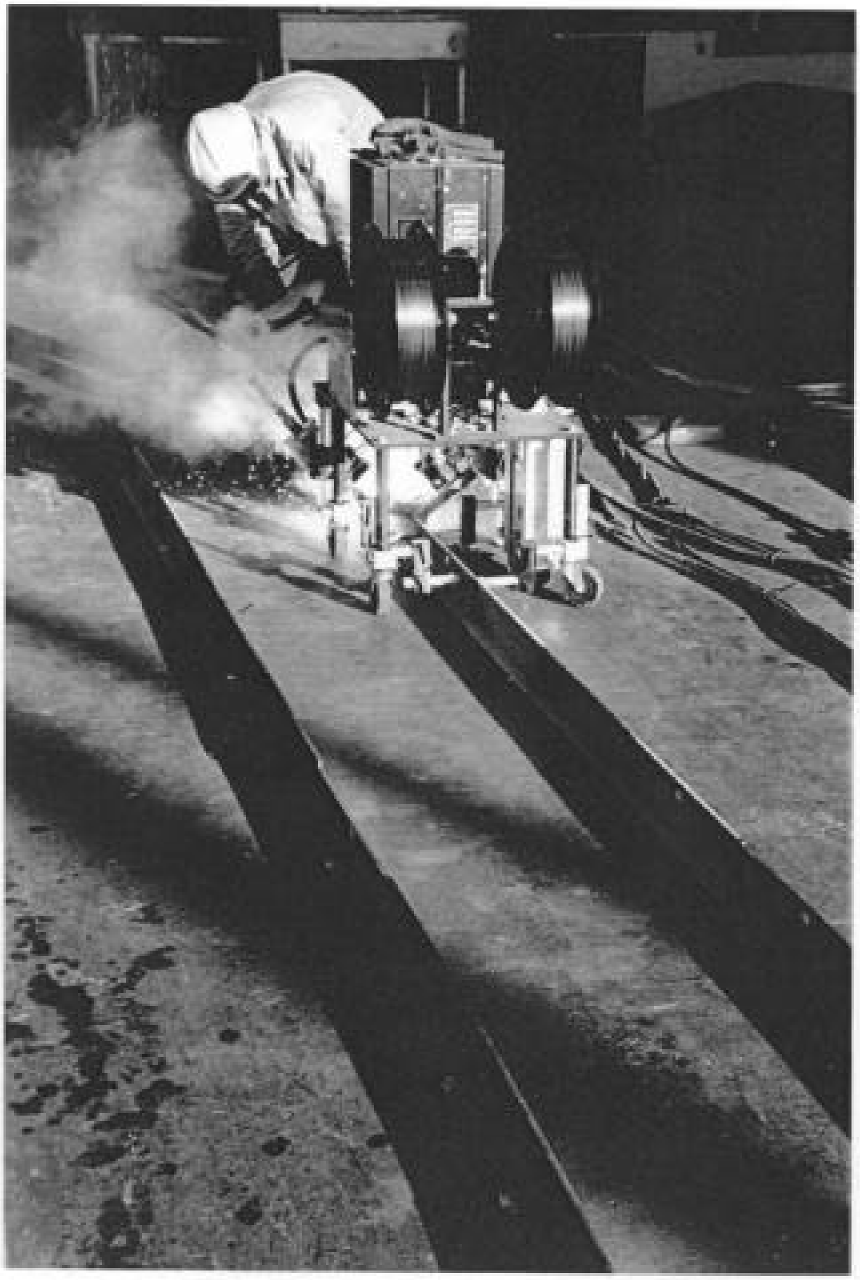


Figure 2-17 Photograph showing fillet welding of primer-coated web-and-flange assemblies using a Lincoln twin-arc welding machine. This machine is used in production operations at the McDermott Shipyard in Amelia, LA.

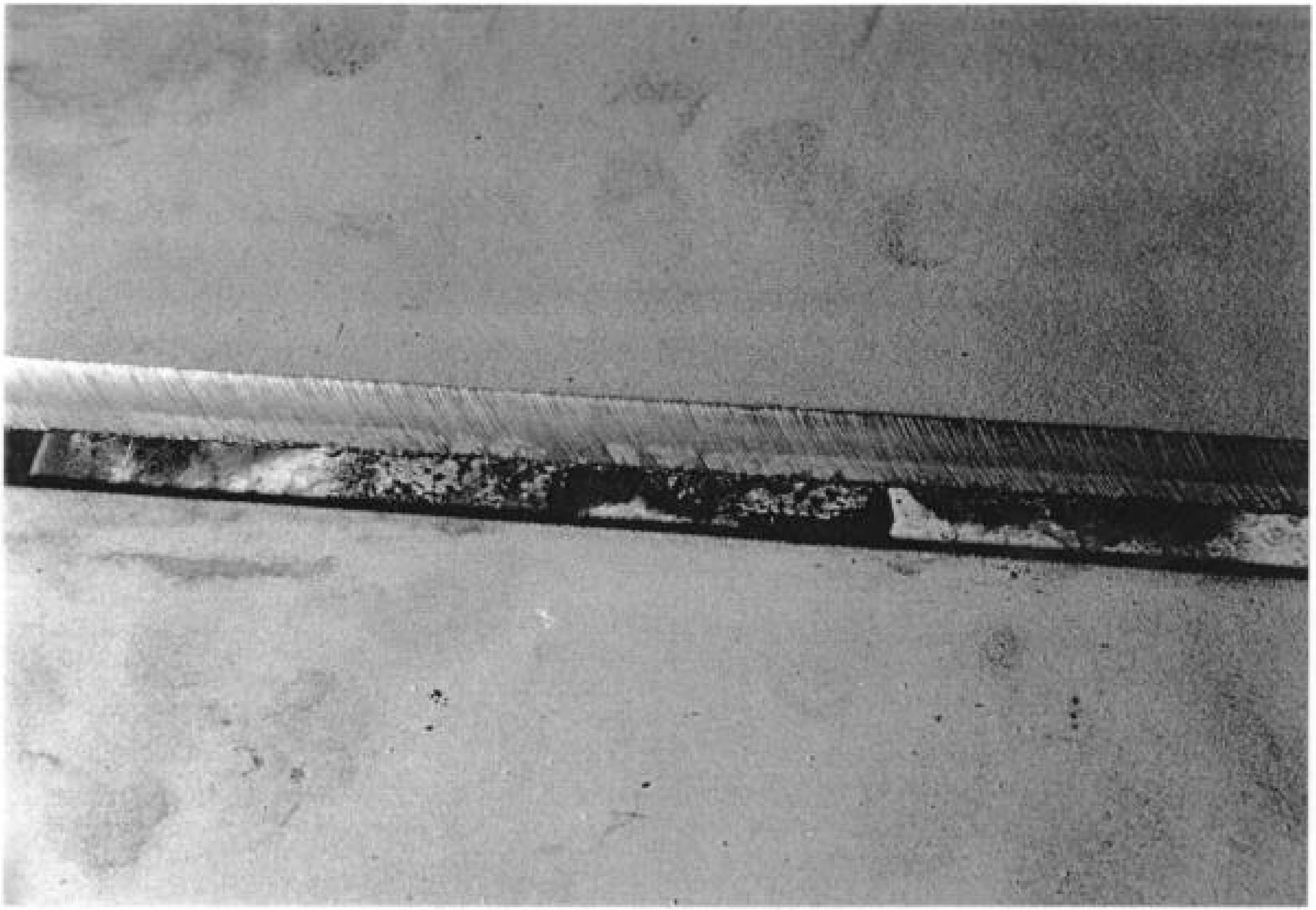


Figure 3-1 Photograph showing the surface characteristics and uniformity of the kerf resulting from plasma torch cutting a typical primer-coated 3/8" thick panel.

Figure 3-2 Photograph showing web-and-flange sections and fillet welds with linear surface porosity.

Figure 3-3 **Photograph with inset arrows showing the flaws (porosity) at the fracture surface of a typical fillet weld in a primer-coated web-and-flange section.**

APPENDICES

APPENDIX 2-1

Product Data Sheets for Water-Thinned Preconstruction Primers Selected for Laboratory and Shipyard Testing

Ameron

Amercoat® 3207

Waterborne epoxy preconstruction primer

Product Data/ Application Instructions

- Low odor
- Weldable primer
- Long pot life
- VOC compliant
- Excellent corrosion resistance
- Clean and thin with water
- Fast drying
- Compatible with water-based and solvent-based epoxy coatings

Typical Uses

Amercoat 3207 primer provides excellent corrosion protection for steel as a weldable preconstruction primer.

Surface Preparation

Coating performance is proportional to the degree of surface preparation. Abrasive blasting is usually the most effective and economical method to remove rust and mill scale. Prior to coating, surface must be cleaned, dry, undamaged and free of all contaminants, including salt deposits. Round off all rough welds and sharp edges, remove all weld spatter.

Steel – Shot blast per SSPC-SP10 to achieve a 1-2 mil (35 to 65 microns) profile as indicated by a Keane Tator Surface Profile Comparator, Testex Tape or similar device.

Apply Amercoat 3207 as soon as possible to avoid rusting or other recontamination. Do not leave blasted steel uncoated over night. Spot blast to remove any contamination; solvent wiping is not satisfactory.

Galvanizing – Remove oil or soap film with neutral detergent or emulsion cleaner. Then use zinc treatment such as Galva-prep® or equivalent or blast lightly with fine abrasive.

Aluminum – Remove oil, grease or soap film with neutral detergent or emulsion cleaner; treat with Alodine®, Alumiprep® or equivalent or blast lightly with fine abrasive.

Application Equipment

The following is a guide; suitable equipment from other manufacturers may be used. Changes in pressure, hose and tip size may be needed for proper spray characteristics.

Airless – Standard equipment such as Graco Bulldog Hydra-Spray 30:1 or larger with a 0.015- to 0.019-inch spray tip.

Conventional spray – Industrial equipment such as DeVilbiss MBC or JGA or Binks BBR spray gun. A moisture and oil trap in the main air supply line, a pressure material pot with a mechanical agitator and separate regulators for air and fluid pressure are recommended.

Power mixer – Jiffy Mixer powered by an air or an electric motor.

Physical Data

Finish	Flat	
Color	Oxide red	
Components	2	
Curing mechanism	Solvent release and chemical reaction between components	
Volume solids (ASTM D2697 modified)	39% ± 3%	
Dry film thickness per coat*	1 mil (25 microns)	
Coats	1	
Theoretical coverage	ft²/gal	m²/L
1 mil (25 microns)	625	15.3
VOC	1.9 lb/gal	228 g/L
Flash point (SETA)	°F	°C
cure and resin	>200	>93
Amercoat 12	0	-18
Amercoat 928	175	79

Application Data

Applied over	Prepared steel, aluminum, galvanizing		
Surface preparation	Shot blast SSPC-SP10		
Method	Spray airless or conventional		
Mixing ratio (by volume)	1 part cure to 8 parts resin		

Pot life / Induction time	°F/°C		
	90/32	70/21	50/10
pot life (hours)	12	24	48
inductions time (min)	10	20	40

After mixing resin and cure allow for induction time before application.

Environmental conditions		
Temperature	°F	°C
air	50 to 110	10 to 43
surface	50 to 120	10 to 49
Relative Humidity	85% maximum	

Surface temperatures must be at least 5°F (3°C) above dew point to prevent condensation.

Drying time (ASTM D1640)	°F/°C		
	90/32	70/21	50/10
touch (minutes)	3	5	20
recoat 1 topcoat minimum (hours)	$1\frac{1}{2}$	2	48
maximum	None		

Thinner	Fresh water
Equipment cleaner	Fresh water, Amercoat 12 or 928

Qualifications

Weldable in accordance with MIL-STD-248 D Paragraph 4.4.1.12

*Film thickness should average 1 mil and the maximum film build over the area should be $1\frac{1}{2}$ mils to maintain weldability

Application Procedure

Amercoat 3207 is packaged in the proper proportions which must be mixed together before use.

1. Flush equipment with Amercoat 12, followed by fresh water before use.
2. Stir resin using power mixer to disperse pigments.
3. Add cure and mix thoroughly until uniformly blended. **Induction time before application is required** for proper film build and appearance. Insufficient mixing (low speed or manual mixing) will result in poor emulsification and consequently be detrimental to coating performance.
4. Conventional spray may require thinning for workability. add up to 1/2 pint water per gallon of Amercoat 3207. Do not exceed thinning limit. Film build will be reduced. Airless spray-thinning normally not required.
5. Apply a wet coat in even, parallel passes; overlap each pass 50 percent to avoid bare areas, pinholes and holidays. If required, cross spray at right angles to first pass.
6. Ventilate with clean air during application and drying. Temperatures and relative humidity of ventilating air will affect drying times. Avoid contact with water or condensation on coating surface until dry through; otherwise, surface discoloration may occur.
7. Clean all equipment immediately after use with clean, warm water, followed by Amercoat 12 to remove any partially dried material and moisture.

Safety Precautions

Read each component's material safety data sheet before use. Mixed material has hazards of each component.

CAUTION – Improper use and handling of this product can be hazardous to health.

Do not use this product without first taking all appropriate safety measures to prevent property damage and injuries. These measures may include, without limitation: implementation of proper ventilation, use of proper lamps, wearing of proper protective clothing and masks, tenting and proper separation of application areas. Consult your supervisor. Proper ventilation and protective measures must be provided during application and drying to keep spray mists and vapor concentrations within safe limits and to protect against toxic hazards. Necessary safety equipment must be used and ventilation requirements carefully observed, especially in confined or enclosed spaces, such as tank interiors and buildings.

This product is to be used by those knowledgeable about proper application methods. Ameron makes no recommendation about the types of safety measures that may need to be adopted because these depend on application environment and space, of which Ameron is unaware and over which it has no control.

If you do not fully understand these warnings and instructions or if you cannot strictly comply with them, do not use the product.

Note: Consult Code of Federal Regulations Title 29, Labor, parts 1910 and 19__ concerning occupational safety and health standards and regulations, as well as any other applicable federal, state and local regulations on safe practices in coating operations.

This product is for industrial use only. Not for residential use in Califor__.

Shipping Data

Packaging units	1 gal	5 gal
cure	0.11 gal in 1/2 pt can	0.55 gal in 1-gal can
resin	0.89 gal in 1-gal can	4.45 gal in 5-gal can

Shipping weight (approx)	lb	kg
1-gal unit		
cure	1.1	0.5
resin	10.5	4.8
5-gal unit		
cure	6.0	2.7
resin	51	23.1

Shelf life when stored indoors at 40 to 100°F (4 to 38°C)
cure and resin — 6 months from shipment date

Protect from freezing.

Numerical values are subject to normal manufacturing tolerances, color and testing variances. Allow for application losses and surface irregularities.

The mixed product is photochemically reactive as defined by South Coast Air Quality Management District's Rule 102 or equivalent regulations.

Typical Properties

Elongation (ASTM D522)	>35%
Impact resistance (3 mils) (ASTM G14)	17 in lbs
Rapid deformation (3 mils) Reverse (ASTM D2974)	>160 in lbs
Moisture vapor transmission Specific Permeability (24 hrs) (ASTM D1653)	0.77 mm mg/cm²

Warranty

Ameron warrants its products to be free from defects in material and workmanship. Ameron's sole obligation and Buyer's exclusive remedy in connection with the products shall be limited, at Ameron's option, to either replacement of products not conforming to this Warranty or credit to Buyer's account in the invoiced amount of the nonconforming products. Any claim under this Warranty must be made by Buyer to Ameron in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life, or one year from the delivery date, whichever is earlier. Buyer's failure to notify Ameron of such nonconformance as required herein shall bar Buyer from recovery under this Warranty.

Ameron makes no other warranties concerning the product. No other warranties, whether express, implied, or statutory, such as warranties of merchantability or fitness for a particular purpose, shall apply. In no event shall Ameron be liable for consequential or incidental damages.

Any recommendation or suggestion relating to the use of the products made by Ameron, whether in its technical literature, or in response to specific inquiry, or otherwise, is based on data believed to be reliable; however, the products and information are intended for use by Buyers having requisite skill and know-how in the industry, and therefore it is for Buyer to satisfy itself of the suitability of the products for its own particular use and it shall be deemed that Buyer has done so, at its sole discretion and risk. Variation in environment, changes in procedures of use, or extrapolation of data may cause unsatisfactory results.

Limitation of Liability

Ameron's liability on any claim of any kind, including claims based upon Ameron's negligence or strict liability, for any loss or damage arising out of, connected with, or resulting from the use of the products, shall in no case exceed the purchase price allocable to the products or part thereof which give rise to the claim. In no event shall Ameron be liable for consequential or incidental damages.

Ameron.
Protective Coatings
Group

201 North Berry Street, Brea, California 92622-1020 • J. F. Kennedylaan 7, 4191 MZ Geldermalsen, The Netherlands

Ameron

TECHNICAL INFORMATION BULLETIN
NUMBER 91-1

AMERCOAT 3207 - SHOP PRIMER USE

Amercoat 3207 is a water-based epoxy primer that has recently been tested at Avondale Shipyard as a water-based pre-construction primer (PCP). Avondale has been experiencing environmental problems using zinc-rich PCPs. These environmental problems are related to the blasting off of the PCP with consequent pollution of water around the shipyard with zinc. In testing they have found that Amercoat 3207 meets their needs for a more environmentally friendly PCP.

Features and Benefits:

1. Water-based - Ease of thinning and clean-up with water, lowers solvent costs.

2. Low VOC and high flash point.

3. Potlife of 24 hours which fits well with shop application techniques.

4. Fast dry - At Avondale at 85°F (see Attachment 4, Application Forms) they report 3 minutes tack-free and 9 minutes nail-hard. Also see Attachment 2, Cure Schedule, which is a chart of dry at high temperatures which allow fast through-put on a heated line.

5. Can be applied at 0.5 to 1.5 mils with water thinning.

6. Weldable at average film thickness of 1 mil and maximum film thickness of 1.5 mils per MIL-STD-248D. Application above this millage adversely affects weldability. See Attachment 4, Weld Reports from Avondale. Note: Steel profile should be maintained below 1.5 mils for optimum corrosion resistance.

7. Amercoat 3207 will offer good corrosion protection for 3-6 months dependent on the storage conditions of the steel.

8. Excellent compatibility of Amercoat 3207 with many types of coating, see the attached list.

NOTE: Attached welding tests were performed to MIL-STD-248D and welding was witnessed by representatives of U.S. Navy and ABS.

AMERCOAT 3207 - COMPATIBILITY LISTS

Generic Type	Product Name	Maximum Topcoat Window*
Epoxy	Amercoat 3207	Unlimited
	Amerlock 400	Unlimited
	Amercoat 385	Unlimited
	Amercoat 3151	Unlimited
	Amercoat 3217	Unlimited
	Amercoat 395FD	Unlimited
	Amercoat 83A	Unlimited
	Amercoat 81A	Unlimited
	Amercoat 3171	Unlimited
	MIL-P-24441	Unlimited
Coal Tar/Epoxy	Amercoat 78HB	Unlimited
	Amercoat 344	Unlimited
Coal Tar/Vinyl	Amercoat 245	1 week**
Urethane	Amershield	1 month**
	Amercoat 450HS	1 month**
	Amercoat 3154A	1 month**
Chlorinated Rubber	Amercoat 512	3 days
Vinyl	Amercoat 99R	1 week**
	Amercoat 99SG	1 week**
	Amercoat 234	1 week**
Water-based	Amercoat 148	1 day
	Amerguard 220	1 day
	Amerguard 335	Unlimited
	Amercoat 208 (DOD-C-24596)	1 day
	Amercoat 3207	Unlimited

Wrt 4/84

carboline.

350 Hanley Industrial Ct - St. Louis, MO 63144-1599
an RPM Company - 314-644-1000

Technical Information Bulletin

Carboline 8101

Carboline 8000 Series Materials have been specifically designed for OEM applications. Any other use is not recommended without first consulting with the Carboline Company OEM Team or the Carboline Company Technical Service Department.

General

Generic type:
Waterborne Acrylic

General Properties:
VOC Compliant
Low Odor
Convenient Single Package
Direct to Metal (DTM)
Spray or Dip Application
Excellent Weathering Resistance
Excellent Chemical Resistance
Fast Cure
Thin Film
Force Cure for Optimum Performance

Ordering

Storage Conditions:

Store Indoors
Temperature: 45-110°F (4-43°C)
Humidity: 0 to 95%
Keep from freezing

Shelf Life
12 Months when stored at 75°F

Flashpoint (Seta Flash):
>200°F

Typical Shipping Weights:

1 Gallon Cans:	11 Pounds	5 Kilograms
5 Gallon Pails:	51 Pounds	23 Kilograms
50 Gallon Drums:	600 Pounds	271 Kilograms
Totes:		

Technical

Solids by Volume:	39% ±2%
Recommended DFT/coat:	1 - 2 Mils
Theoretical Coverage /Coat:	417 Sq. Ft./Gal

Typical drying and curing times:

Dry to touch at 75°F: 30 minutes
Dry to handle at 75°F:
Dry to recoat at 75°F:
Dry to stack at 75°F:
Dry to full cure at 75°F:
Drying and curing times are affected by many variables. On site testing is always necessary to be certain.

Times include a total of flash off, bake and cool down time. Times and temperatures shown are based on in-house testing and will vary depending on oven type and substrate size

Force Cure Information

Time to handle	Temperature
15 Minutes	150°F

Adhesion to:

Cold Rolled Smooth Steel:	Excellent
Abrasive Blasted Steel:	Excellent

Not recommend when blast profile will exceed film thickness.

Smooth Aluminum:	Excellent
Phosphatized Steel:	Excellent

Gloss: Semi-Gloss
Color: As Required
Color Pigments used are Lead and Chromate Free
Thinning and Cleanup:
May be thinned up to 5% with clean potable water where conditions dictate.
For cleanup use clean water followed with Carboline Thinner #21.

Typical VOC, will vary based on color:

EPA Method 24:	1.1 Lbs/Gal
Per actual gallon:	.5 Lbs/Gal
EPA Method 24:	132 gms/l
Per actual gallon:	59 gms/l

KEY CHARACTERISTICS 8101

#8101 - ACRYLIC "HYBRID" WATER BORNE PRECONSTRUCTION PRIMER

- Single Pack - Ready to Use - No thinning necessary
- Easily applied to weldable thickness. Thin film application with existing pre-construction primer equipment is easy.
- Water-borne - Minimal VOC (Only 0.5 lbs. / gal. VOC)
- Excellent adhesion to sandblasted steel.
- Clean up with water.
- Accepts a variety of generic topcoats.

#8101 ACRYLIC PRODUCT FACTS

Sizes:	1 gallon cans	-	5 gallon cans	-	50 gallon drums
Shipping Wt:	11 pounds		51 pounds		550 pounds

- Flash Point (S ETA Flash) - Greater than 200°F.
- Coverage 625 sq. ft. @ one (1) mil (Theoretical)
- Shelf life - One (1) year when stored at 75°F.

0086309.RM

VOC Compliant Water-Borne Weldable Primers

Water-Borne Carbo Weld D7	OR	#8101 Acrylic Hybrid

Application	
• Faster dry • Saves fuel on pre-heating • Two components mix in base can • May require heating in humid conditions for quick dry. • High coverage, less mixing. 727 square feet @ 1 mil	• Will require pre-heat or post cure for rapid dry-to-handle under extreme conditions • Single component 5 gal or drums • Excellent coverage - 625 square feet @ 1 mil • Water thinned
Performance	
• Superior corrosion resistance to traditional PCP's • Salt formation requires removal to topcoat/overcoat	• Very good corrosion resistance • Available in a variety of colors for alloy distinction • Receives various generic topcoats
Environmental	
• Zero VOC • Water clean-up	• Minimum VOC (0.5 lbs. gal.) • Higher coverage, fewer cans to dispose of • Water clean-up

Carboline offers three VOC compliant pre-construction primers to best suit your specific needs. Carbo Weld® primers follow a long Carboline tradition of superior inorganic zinc primers.

Carboline 8101 offers a water-borne acrylic alternative to zinc primers.

July 14, 1994

Title: Topcoat Adhesion of Carboline Coatings over Weathered Carboline 8101

References: L488-124; L488-132

Purpose: To evaluate recoatability of various generic topcoats over weathered Carboline 8101.

Procedure: Applied the following over weathered Carboline 8101 (aged 17 days - midwest weathering) and evaluate adhesion using an Elcometer adhesion tester.

1) Carbomastic 15 LO
2) Carboline 801
3) Carboline 833
4) Carboline 3359

Weathered 8101 Recoatability Results

DFT Range 1.1 - 1.2 mils

Topcoat	DFT, mils	Adhesion, psi	Mode of Failure
Carbomastic 15 LO	4.6	800	95% adhesive failure of primer, 5% glue failure
Carboline 801	4.3	900	98% adhesive failure of primer, 5% glue failure
Carboline 833	3.0	850	70% adhesive, 30% cohesive failure of topcoat
Carboline 3359	3.2	800	90% glue failure, 2% adhesive failure of topcoat

Carolyn Rice

Carolyn Rice
Advanced Chemist
Jul-94

From the Carboline Research & Development Laboratory

Since 1754

DEVOE COATINGS

Marine·Industrial·Offshore

Devran® 720

Water Based Acrylic Epoxy
Preconstruction Primer
Catalog Number 720-K-XXXX

FEATURES

Long pot life
- Up to 8 hours

Water based product
- Non flammable

Low V. O. C.

Fast dry
- Will dry on most roto blast lines

Weldable
- Quality welds at production line speeds

Corrosion Protection
- Excellent

Compatible
- Can be topcoated with most high performance solvent based epoxies after 24 hours.

RECOMMENDED USES

Devran 720 Primer is an ideal preconstruction primer designed to work on automatic roto blast and shape lines:

- Provides corrosion protection throughout fabrication.
- Will work on automatic welding equipment

Devran 720 Primer is a suitable shop primer for:

- Steel fabrication
- Ship construction
- Offshore construction
- Industrial construction

Special Order/Non-Stocking item

SPECIFICATION DATA

Coating Type	Water based acrylic epoxy
Colors	**Catalog Number**
Red	720-K-7250
Packaging	5 Gallon (1:1) 10gl kit only Two component kit
Flash Point	N/A (Aqueous System)
Density	11 Lbs/Gal (1.32 kg/l)
Thinner	Water
Pot Life	8 hours at 77°F
Shelf Life	More than 1 year
Induction Time	≥75°F - 15 minutes ≤70°F - 30 minutes
Component Ratio	1:1 by volume

VOC EPA 24	0.72 Lbs/Gal (87 Grams per liter)
Temp. Resistance	250°F (121°C) dry
Volume Solids	43%
Theoretical Spreading Rate	688 Sq. Ft/Gal at 1 mil 16.9 Sq. m/l at 25 microns
Recommended Film Thickness	2-3 mils wet to obtain 0.8 - 1.2 mils dry
Application	Automatic air or airless spray
Dry Time	Touch - 15 minutes at 75°F Thorough - 2 hours at 75°F

PERFORMANCE DATA

Devran 720 Preconstruction Primer

Abrasion resistance ASTM D 4060 Taber CS17 1000 gram load	Excellent: 146 mg loss/1000 cycles
Volume Solids ASTM D2697	43%
Cleveland Humidity ASTM D2247 (2000 Hrs) 720/235/235	Excellent: No blistering, cracking, softening or adhesion loss.
Salt Spray ASTM B 117 (2500 Hrs) 720/235/235	Excellent, moderate rust at scribe, no blisters, cracking, sofenting or adhesion loss
Water Immersion S.S.W. at R.T. (1 Year) 720/235/235	Excellent, moderate rust at scribe, no blisters, cracking, softening or adhesion loss

PERFORMANCE DATA
DEVRAN 720 PRECONSTRUCTION PRIMER

Flexibility 180 Degrees		Excellent, no cracking and flaking
Impact ASTM G 14	Forward Impact Reverse Impact	32 inch pound-Pass 60 inch pound-Pass
Adhesion ASTM D 4541 Elecometer Adhesion Tester		700-750 p.s.i.
Welding	Mil-Std-248D	Pass

DEV 720 - COMPATIBILITY LISTS

Generic Type	Product Name	Maximum Topcoat Window over Dev 720
Epoxy	Bar Rust 235	Unlimited
	Bar Rust 236	Unlimited
	Devtar 5A	Unlimited
	Dev. 230	Unlimited
	Dev. 224HS	Unlimited
	Dev. 201	Unlimited
	Mil-P-24441	Unlimited
Urethane	Devthane 369	Unlimited
	Devthane 379	Unlimited
Chlorinated Rubber	Devchlor 470	3 Days
Water-based	Dev. 646	Unlimited
	Devflex 604	1 Day
	Devflex 601	1 Day
	Dev 720	Unlimited

VENDOR SURVEY
WATER-THINNED PCPs WITHOUT HAZARDOUS METAL PIGMENTS
NSRP Project 3-95-3.

Coating Designation:	HEMUDUR SHOPPRIMER 18580
Manufacturer's Name:	Hempel Coatings (U.S.A.) Inc.
Resin Type:	Epoxy-dispersion cured with amineadduct.
VOC Content:	1.3 lbs/US gallon (155 g/litre) (water reduced)
Percent Solids:	43% volume solids as supplied. Dilute approximately 30% with water before application.
Hazardous Metal Content:	Nil
Compatibility:	Can be recoated with one- and two-component soventborne paints i.e vinyls, acrylics, chlorinated rubber and epoxy.
Surf. Prep. Requirements:	Abrasive blasting to cleaning degree specified for final coating system, usually SSPC-SP-10 (Sa 2½).
Application Requirements:	To be able to evaporate the water within a short time and filmform the paintfilm, it is necessary to preheat the steel to min. 104°F (40°C). Minimum 68°F (20°C) is recommended in the drying zone. If the drying is delayed due to high relative humidity in the drying zone, the RH can be reduced by heating the air in this area.
Recommended DFT:	15-25 micron / 0.6-1 mil
Drying Time:	On a 104°F (40°C) smooth steel panel 18580 in 25 micron / 1 mil dry film thickness dries in 3 min./ 68°F (20°C), 40% RH.
Curing Time:	Fully cured after one week at 68°F (20°C).
Shelf Life:	Min. one year at 68°F (20°C).
Approximate cost:	
Case Histories:	Successful applications at automatic shopprimer plants at Forge de Clabecq, Belgium and British Steel, England.

DRAFT

DATA SHEET **HEMUDUR SHOPPRIMER 18580**

DESCRIPTION: HEMUDUR SHOPPRIMER 18580 is a waterborne two-component epoxy based shopprimer. It is especially designed for automatic spray application.

RECOMMENDED USE: For protection of blastcleaned steel during storage, fabrication and construction periods.
It is important that the shoppriming plant is able to preheat the steel to min. 40°C/104°F before application.

PHYSICAL CONSTANTS:

Finish:	Flat	
Colours/shade Nos:	Red/51320	
Volume solids:	43%	
Theoretical spreading rate:	See REMARKS overleaf	
Flash point:	Non-flammable	
Specific gravity:	1.3	kg/litre
	10.8	lbs/US gallon
Dry to touch:	See REMARKS overleaf	
Fully cured:	1	week at 20°C/68°F

APPLICATION DETAILS:

Mixing ratio:	BASE: HEMUDUR SHOPPRIMER 18589 0.45 part per volume CURING AGENT: 97780 0.55 part per volume After mixing the BASE and the CURING AGENT the paint must be thinned with 30% by volume with fresh water.	
Application method:	Airless spray Airmix spray	
Thinner (max.vol.):	fresh water (30%) fresh water (30%)	
Pot life:	8 hours(20°C/68°F,drying at 40°C/104°F)	
Nozzle orifice:	.015"-.019"	(See REMARKS overleaf)
Nozzle pressure:	Min. 100 bar/1500 psi (spraying data are indicative and subject to adjustment)	
Cleaning of tools:	Fresh water	(See REMARKS overleaf)
Indicated film thickness:	wet: not relevant dry: 15 micron/0.6 mils	(See REMARKS overleaf)
Recoat interval:	min: 6 hours (20°C/68°F) max: Intet	(See REMARKS overleaf)

SURFACE PREPARATION: Remove oil and grease, etc with suitable detergent. Remove salt and other contaminants by (high pressure) fresh water cleaning. Abrasive blasting to cleaning degree specified for final coating system, usually Sa 2 1/2.

APPLICATION CONDITIONS: To be able to evaporate the water within a short time and filmform the paintfilm, it is necessary to preheat the steel to min. 40 °C (104°F). Minimum 20°C is recommended in the drying zone. If the drying is delayed due to high relative humidity in the drying zone, the RH can be reduced by heating the air in this area.

PRECEDING COAT: None

SUBSEQUENT COAT: According to specification.

REMARKS:

Filmthickness: Recommended dry film thickness: 20-25 micron/0.8-1 mil measured on a smooth test panel.
Excessive film thickness must be avoided.
On steel abrasive blasted to a profile Ra = 12½ (½ mil), equivalent to Rugotest No.3, N10a-b, Keane-Tator Comparator, 3.0 mils segments, or ISO Comparator Medium (G), the indicated 15 micron/0.6 mil film thickness corrosponds to approx. 25 micron/1 mil measured on a smooth test panel. Corresponding "theoretical" spreading rate after dilution with 30% of water will be 13.1 m²/litre (526 sq.ft./US gallon).
On steel abrasive blasted to a profile Ra = 6.3 micron (¼ mil), equivalent to Rugotest No. 3, N9a, Keane-Tator Comparator, 2.0 mils segment, or ISO Comparator Fine (G) the indicated 15 micron/0.6 mil film thickness corrosponds to approximately 20 micron/0.8 mil measured on a smooth test panel.
The corresponding "theoretical" spreading rate after dilution with 30% water will be 16.5 m²/litre (662 sq.ft./US gallon)

Drying time: On a 40°C smooth steel panel 18580 in 25 micron dry film thickness dries in 3 min./20°C, 40% RH.

Nozzle orifice: For proper filmformation it is important to use the recommended nozzle size.

Recoating: No maximum recoat interval for adhesion, but dictated by gradual breakdown and damage during exposure and fabrication.

Cleaning of tools: Tools must be cleaned immediately with fresh water or lukewarm soap water. Dried paint residues may be removed by use of HEMPELS NAVI WASH 99330 undiluted or HEMPELS TOOL CLEANER 99610.

Shelf life/storage: Store at temperatures between 5-40°C/40-105°F. The shelf life is reduced at temperatures above 30°C/86°F. Do not expose to frost during storage and transportation.

VOC: The Volatile Organic Compounds are 155 g/litre, 1.30 lbs/US gallon.

Intergard® 292 WB

Waterborne Epoxy Pre-construction Primer

Intended Uses

A pre-construction primer for the protection of steel during fabrication and assembly. Long term weathering protection. Good cutting performance. Satisfactory welding performance. Excellent compatibility with a wide range of generic topcoats.

Product Description

A two-pack waterborne epoxy pre-construction primer. Low Odor. Low VOC.

Product Information

Color	NHA209-Red
Finish/Sheen	Not applicable
Converter	NHA210
Volume Solids	31% ± 2% (ASTM D-2697)
Mix Ratio	4:1 by volume
Flash Point	Greater than 200°F for both components and mixed paint.
Film Thickness	1.0 mils dry specified equivalent to 3.2 mils wet. 0.8-1.2 mils dry practical range equivalent to 2.6-3.9 mils wet.
Theoretical Coverage	497 sq. ft./gal. (1.0 mils DFT) Allow appropriate loss factors

Application Details

Method	Conventional and airless spray
Induction/Sweat-in Time	30 minutes @ 73°F (23°C)
Thinner	Fresh potable water
Cleaner	Fresh potable water
Pot Life	Shows @ 73°F (23°C)

Drying Time *(hours)* Substrate Temperature	*(ASTM D 1640 7.5.1)* Touch	*(ASTM D 1640 7.7)* Handle	Overcoating Interval By Self *(ASTM D-1640 7.8)* *Minimum*	*Maximum*
50°F (10°C)	2-3 hours	15 minutes	24	Indefinite
73°F (23°C)	45-60 minutes	10 minutes	24	Indefinite
95°F (35°C)	30 minutes	8 minutes	24	Indefinite

Regulatory Data

VOC	2.25 lbs/gal (270 g/ltr) as supplied (EPA Method 24)

Intergard® 292 WB

Waterborne Epoxy Pre-construction Primer

Consult your International Representative for the system best suited for surfaces to be protected.

COMPATABILITY

Intergard® 292 WB is compatible with a wide range of specified topcoats

TYPICAL SYSTEMS

Intergard® 292 WB/Intergard® FP

LIMITATIONS

Apply in good weather when air and surface temperatures are above 50°F (10°C). Surface temperature must be at least 5°F (3°C) above dew point. For optimum application properties, bring material to 70-80°F (21-27°C) temperature range prior to mixing and application. Unmixed material (in closed containers) should be maintained in protected storage between 40 and 100°F (4-38°C).

Technical and application data herein is for the purpose of establishing a general guideline of the coating and proper coating application procedures. Test performance results were obtained in a controlled laboratory environment and International makes no claim that the exhibited published test results, or any other tests, accurately represent results actually found in all field environments. As application, environmental and design factors can vary significantly due care should be exercised in the selection, verification of performance, and use of the coating.

SURFACE PREPARATION

Paint only clean, dry surfaces. Remove all grease, oil, wax, or other foreign matter by solvent or detergent washing (SSPC-SP1).

Steel: Apply to blasted steel only. Steel Structures Painting Council No. 10 "Near White Metal Blast Cleaning" (SSPC-SP10). Blasting shall be done with a centrifugal wheel or compressed air blasting equipment using proper abrasives to attain an average profile depth of 1.5 mils (38 microns). Do not reuse sand or flint abrasives. Grit shall be incorporated with shot at a minimum ratio of 25:75, grit to shot mix. Remove dust and grit from surface prior to coating. Coat within 8 hours or before contamination occurs.

Intergard® 292 WB

Waterborne Epoxy Pre-construction Primer

MIXING

Material is supplied in 2 containers as a unit. Always mix a complete unit in the proportions supplied. (1) Agitate Part A with a power agitator. (2) Combine entire contents of Part A and B and mix thoroughly with a power agitator. (3) Allow the coating a 30 minute sweat-in period, at temperatures below 73°F.

APPLICATION

Apply by conventional or airless spray. Application by other methods, brush or roller, may require more than one coat. Strain material through a minimum 60 mesh screen before application. Apply at 3.2 mils wet (80 microns) which will yield 1.0 mils (25 microns) dry film thickness. Consult the following equipment recommendations and/or utilize suitable equal.

Equipment

Conventional Spray: DeVilbiss MBC-510 gun E tip and 704 air cap; 3/8" ID material hose; double regulated pressure tank with oil and moisture separator.
Airless Spray: Minimum 28:1 ratio pump; .015"-.021" (381-533 microns) orifice tip; 1/4" ID high pressure material hose; 90 PSI line pressure; 60 mesh tip filter.

Curing

The curing time will vary depending upon dry film thickness and conditions that exist during the application and throughout curing periods. The rate of cure can be accelerated by force curing the coating for 5 minutes at 150°F.

THINNING

DO NOT THIN BEYOND YOUR STATE'S COMPLIANCY. Material is supplied at spray viscosity and normally needs no thinning. If thinning is necessary, deionized or distilled water is preferred since some tap waters could possibly affect pot life and performance characteristics. Thin only with amount necessary to obtain proper application and/or atomization (break-up) properties.

WORK STOPPAGES
(Lunch, Breaks, etc.)

Do not allow material to remain in hoses. Release pressure from pressure tank and disconnect material hose. Thoroughly flush hose and spray gun with International GTA*** Thinner and reconnect to tank. Do not repressurize tank until ready to resume work. Monitor material condition. Do not exceed pot life limitations.

VENDOR SURVEY
WATER-THINNED PCP'S WITHOUT HAZARDOUS METAL PIGMENTS
NSRP PROJECT 3-95-3

Coating Designation:	Sovaprime Universal Primer (13R96)		
Manufacturers Name:	Jotun – Valspar Corporation		
Resin Type:	Epoxy		
VOC Content:	128 gm/ltr (1.07 lbs/gal)		
Percent Solids:	46%		
Hazardous Metal Content:	None		
Compatibility:	Compatible with solvent-borne epoxies, urethanes, alkyds, and water-borne epoxies & acrylics.		
Surface Prep. Requirements:	Clean, rust free surface, blasted to SSPC-SP 10 (Swedish Std. SA 2 1/2)		
Application Requirements:	Conventional and airless spray (brushing for only limited areas).		
Recommended DFT:	1.0–1.5 mils (25–37 μm)		
Drying Time:	at 75°F:	To touch: To recoat:	10 minutes 8 hours
Curing Time:	at 75°F:	Full cure after 7 days.	
Shelf Life:	12 months		
Approximate Cost:	$23.00/gallon		
Case Histories:			

JOTUN VALSPAR
Technical Data

SOVAPRIME UNIVERSAL PRIMER
13R96

PRODUCT DESCRIPTION: Water reducible universal epoxy primer.

RECOMMENDED USE: To be used as a preconstruction primer on blast cleaned steel surfaces in automatic shop priming plants or as a mid-coat primer in an anti-corrosive priming system.

TECHNICAL INFORMATION:

Colors	: Red		
Solids (% by volume)	: 46.0% +/- 2		
Specific Gravity	: 1.40 +/- .05		
VOC	: 1.07 lbs/gal (128 gm/ltr)		
Viscosity	: 60-70 Krebs Units		
Flash Point	: Over 200°F (83°C)	**Water Resistance**	: Excellent
Gloss	: Flat	**Solvent Resistance**	: Good
Flexibility	: Good	**Abrasion Resistance**	: Good
		Chemical Resistance	: Good

	DFT	WFT	Theoretical Spreading Rate
Application Range:	1.0-1.5 mils (25-37 μm)	2.2-3.3 mils (55-82.5 μm)	738 ft^2/gal (18.4 m^2/ltr) per dry mil (25 μm)
Typical:	1.25 mils (31 μm)	2.75 mils (69 μm)	738 ft^2/gal (18.4 m^2/ltr)

APPLICATION DATA:

Application Methods	: Spray, brush, or roll.
Mixing Ratio	: 9:1 by volume.
Thinner/Cleaner	: Water, use 7T35R for clean-up.
Guiding data airless spray	
Pressure at Nozzle	: 2100 psi (15 MPa 150 kp/cm^2)
Nozzle Tip	: 0.011" to 0.026" (0.28-0.66 mm)
Spray Angle	: 40°
Filter	: Check to ensure that filters are clean.
Max. Thinning Permissible to Obtain	Not applicable as product is thinned with water. A maximum of 10%

SURFACE PREPARATION: Blast cleaning to SSPC-SP 10 (Swedish Std. SA 2½) is recommended.

CONDITIONS DURING APPLICATION: For best results, apply when surface temperature is above 50°F (10°C), and a minimum of 5°F (3°C) above the dew point, and relative humidity is not greater than 85%.

DRYING TIME: Drying times are generally related to air circulation, film thickness, number of coats, and will be affected correspondingly. The figures given in the table are typical with:

- Good ventilation.
- Recommended film thickness.
- One coat on top of inert substrate.

Substrate Temp.	Surface Dry	Hard Dry	Cured	Dry to Recoat [1]	
				Minimum [2]	Maximum [3]
50°F (10°C)	15 Minutes	1 Hour	12 Days	20 Hours	-
73°F (23°C)	5 Minutes	20 Minutes	7 Days	8 Hours	-
95°F (35°C)	3 Minutes	10 Minutes	4 Days	5 Hours	-

1. Recommended data given for recoating with the same generic type of paint.
2. In case of multi-coat application, drying times will be influenced by the number in sequence and by the total thickness of previous coat applied-reference is made to the corresponding system data sheet.
3. The surface should be free from any contamination prior to application of subsequent coat.

COMPATIBILITY:
Can be topcoated with both solvent and water-based epoxies, acrylics and urethanes.

SAFETY INFORMATION:
For detailed information on the health and safety hazards and precautions for use of this product, refer to the Material Safety Data Sheet prior to application.

CAUTION:
This product is for industrial use only and is not intended or suitable for use in or around a household or dwelling.

STORAGE:
The product must be stored in accordance with national regulations. Preferred storage conditions are to keep the containers in a dry space provided with adequate ventilation. The containers should be sealed tightly. Handle with care. Stir well before use.

NOTICE: *Some slight changes in product constants and characteristics may occur as solvent is adjusted to conform with current air pollution regulations. If thinning of product for application, product must comply with applicable VOC regulations after thinning.*

Jotun Valspar Marine Coatings
The Valspar Corporation
1401 Severn Street, Baltimore, MD 21230
(410) 625-7200 (800) 638-7758 FAX (410) 752-0027

APPENDIX 2-2

Results of Panel Substrate Surface Analysis for Possible Chloride Contamination

To
D. L. TURNER - METALLURGICAL ANALYSIS SECTION, ARC

From
S. P. ULBRICHT - WATER TECHNOLOGY SECTION (730), ARC

Customer
CRD

File No.
CPG:97:43489-020:01

Subject
ANALYSIS OF WIPES FROM NSRP PROJECT 3-95-3 PLATES - CPDB

Date
May 30, 1996

This letter to cover one customer and one subject only

You recently requested that the surfaces of several test plates, prepared for coating using various abrasives, be characterized with regard to surface chloride contamination. The samples were submitted at two different times. The initial submission included two 8" x 8" plates, one of which was labeled GP40/85psi, and the other, S-70. The plate labeled GP40 was characterized by a surface condition excessively coarse for coating application, and was submitted as a test piece for the characterization technique. The plate labeled S-70 had been prepared with S-70 steel shot abrasive, and exhibited a satisfactory surface condition. The second submittal consisted of a 4" x 6" plate (stamped N191) having been prepared using S-70 abrasive, and coated on one side. The uncoated side was the surface to be sampled.

The first two plates were sampled and analyzed on May 4, 1996. The second submittal was sampled and analyzed on May 23, 1996. The work was performed according to R&DD Standard Practice Procedures. All analytical results obtained are reported herein; the charge number utilized for this work was 43489-020.

The surfaces of the plates were sampled using Halprin (white linen) wipe cloths pre-cleaned according to ARC Technical Procedure ARC-TP- 592. The sampling was performed per the same procedure; one precleaned wipe was moistened with deionized water, then utilized to swab a 4" x 5" area on each plate. The wipes were then leached in deionized water for one hour at 60°C. The leachates were cooled, adjusted to a known volume, then analyzed for chloride ion per ASTM D512, Method D (ion selective electrode). The chloride values were blank corrected using results obtained on an unused wipe cloth, leached and analyzed in the same manner. The corrected results were then calculated to surface contamination levels, using the surface area wiped. Results are tabulated below.

Test Specimen	Surface Chloride (mg/ft^2)	Surface Chloride (mg/cm^2)
GP40/85psi (May 14)	0.24	0.0003
S-70 (May 14)	0.28	0.0003
N191 (May 23)	0.28	0.0003

cc: R.A. Gleixner
J.M. Jevec
N.J. Mravich
ARC Library

The results indicate that surface chloride contamination is present at very low levels on each of the specimens examined. If you have questions or comments regarding this work, please contact me at extension 7715.

Sandra P. Ulbricht
S. P. Ulbricht

Read and approved by John M. [illegible] 5-30-96
Consulting Engineer

APPENDIX 2-3

Climatological Observation Records for the Amelia, LA Region June 1996 - May 1997

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

(7-69)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): MORGAN City | (River Station, if different) | MONTH: June | 19 86
STATE: LA. | COUNTY: ST. MARY | RIVER
TIME (local) OF OBSERVATION: RIVER | TEMP. 0800 | PRECIPITATION 0800 | STANDARD TIME IN USE: CENTRAL
TYPE OF RIVER GAGE | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day)	RIVER STAGE	REMARKS (Special observations, etc.)
1	87	73	74	0					
2	86	74	76	0					
3	86	66	71	1.43					
4	85	70	72	0					
5	86	72	75	.23					
6	85	73	73	0					
7	86	73	74	.05					
8	86	70	70	.47					
9	86	67	70	0					
10	86	67	68	0					
11	83	68	76	0					
12	85	68	75	0					
13	86	67	75	.05					
14	86	67	79	.04					
15	84	73	74	.22					
16	86	73	74	.02					
17	87	74	76	.02					
18	89	73	74	.02					
19	87	71	77	1.11					
20	84	74	77	.11					
21	88	73	75	0					
22	89	75	76	0					
23	88	74	76	.46					
24	88	72	75	.87					
25	88	73	75	.40					
26	89	72	77	0					
27	92	76	78	0					
28	90	73	74	.50					
29	88	74	75	.05					
30	89	74	77	0					
31									
			SUM						

CHECK BAR (For wire-weight) NORMAL CK. BAR — READING | DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Lewis
U.S. Army Corps of Engineers

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA

STATION INDEX NO. 16-6394-8

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Morgan City
(River Station, if different):
MONTH: July 19 96
STATE: La.
COUNTY: St. Mary
RIVER:
TIME (local) OF OBSERVATION: RIVER / TEMP. 0800 / PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets (Ins. and tenths)	AT OB. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day)	RIVER STAGE	REMARKS (Special observations, etc.)
1	91	74	79	0					
2	91	74	75	0					
3	90	75	78	0					
4	93	77	78	0					
5	92	74	75	0					
6	91	77	79	0					
7	93	77	79	0					
8	59	74	74	0.34					
9	88	73	76	3.00					
10	89	75	77	.93					
11	90	74	77	.09					
12	87	75	79	0					
13	91	77	79	0					
14	91	75	80	.02					
15	91	75	78	.03					
16	87	77	78	0					
17	90	73	77	.31					
18	88	76	77	.03					
19	89	76	77	.09					
20	90	77	77	0					
21	89	76	77	0					
22	88	76	78	0					
23	89	76	76	0					
24	90	75	78	1.10					
25	90	75	77	.30					
26	87	71	73	1.18					
27	83	73	74	.05					
28	87	73	76	0					
29	89	75	76	0					
30	89	74	76	.65					
31	87	76	76	.43					
			SUM	8.59					

CHECK BAR (for wire-weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Rew
SUPERVISING OFFICE: U.S. Army Corps. of Engineers
NWSO LAKE CHARLES, LA
STATION INDEX NO. 16-6394-8

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Morgan City
STATE: La.
COUNTY: St. Mary
MONTH: AUG. 19 96
TIME (local) OF OBSERVATION: TEMP. 0800 PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. MAX	MIN	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (ins. and hundredths)
1	87	74	75	0.01
2	86	76	77	0
3	86	73	78	0.35
4	88	75	78	0.52
5	89	75	73	0
6	90	74	76	0.04
7	89	74	77	0
8	88	75	74	0.21
9	90	75	78	.44
10	91	69	75	.61
11	92	74	74	.36
12	80	72	72	.57
13	83	69	73	1.40
14	86	70	74	0
15	87	70	75	0
16	89	74	75	.15
18	89	73	75	0
19	88	64	76	0
20	89	75	77	.04
21	87	75	76	.35
22	85	73	75	.85
23	86	73	76	.15
24	89	73	76	0
25	88	73	73	.05
26	88	74	75	0
27	87	74	75	0
28	86	73	74	.22
29	87	71	73	0.01
30	87	72	74	0.02
31	87	71	72	0
			SUM	

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds

RIVER STAGE: CONDITION | GAGE READING AT A.M. | TENDENCY

REMARKS (Special observations, etc.)

CHECK BAR (for wire weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Louis
U.S. Army Corps of Engineers

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO.: 16-6394-8

STATION (Climatological): Morgan City (River Station, if different)
STATE: La
COUNTY: St. Mary
MONTH: Sept 19 96
RIVER:
TIME (local) OF OBSERVATION RIVER: TEMP. 0800 PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE: | ELEVATION OF RIVER GAGE ZERO: Ft. | FLOOD STAGE: Ft. | NORMAL POOL STAGE: Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE °F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	AT OB. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	RIVER STAGE CONDITION	GAGE READING AT A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	87	71	72	0												
2	82	72	73	0												
3	86	72	74	0												
4	87	73	74	0												
5	87	70	73	0												
6	87	60	74	0			X									
7	87	73	74	2.52												
8	87	60	76	.02												
9	87	53	75	.36												
10	86	62	74	.30												
11	88	48	74	.17												
12	89	50	75	0												
13	90	74	75	0												
14	90	73	74	0												
15	91	74	74	Trace												
16	86	74	80	.32												
18	89	73	73	.09												
19	87	72	74	0												
20	86	73	75	.45												
21	87	72	74	1.04												
22	83	[illegible]	73	.10												
23	85	66	68	0												
24	85	67	71	0												
25	85	66	70	0												
26	85	69	72	0												
27	86	74	76	0	72											
28	85	63	63	1.29												
29	72	58	57	.07												
30	76	59	60	0												
31																
Σ			SUM													

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a wavy line (~~~) through hours precipitation probably occurred unobserved. A.M. — NOON — P.M.

CHECK BAR (for wire weight) NORMAL CK. BAR: READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Lew
U.S. Army Corps of Engineers
SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO.: 16-6394-8

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION: MORGAN CiTy
MONTH: 10/09 YR. 96
STATE: LA.
COUNTY: St MARY
TIME (local) OF OBSERVATION: TEMP. 0800 PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Obsn. Snow, ice pellets, hail, ice on ground (Ins.)
1	78	60	73	0		
2	84	73	73	.05		
3	82	72	72	.02		
4	80	71	71	0		
5	80	69	72	0		
6	72	64	64	.37		
7	67	63	63	.18		
8	78	62	62	0		
9	68	65	65	0		
10	76	60	60	0		
11	79	57	58	0		
12	73	56	57	0		
13	76	56	64	0		
14	78	64	64	0		
15	79	61	61	0		
16	79	60	66	0		
18	83	66	66	0.22		
19	71	54	54	0		
20	71	54	55	0		
21	75	55	62	0		
22	77	62	69	0		
23	77	45	45	0.47		
24	69	44	53	0		
25	73	54	62	.62		
26	75	62	74	1.20		
27	81	73	73	0.03		
28	84	71	71	0		
29	81	66	67	0		
30	81	66	73	0		
31	78	66	69	0		
			SUM	316		

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a wavy line (~~~) through hours precipitation probably occurred unobserved.
A.M. NOON P.M.

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog, Ice Pellets, Glaze, Thunder, Hail, Damaging Winds. Time of observation if different from above.

RIVER STAGE: CONDITION, GAGE READING AT A.M., TENDENCY

REMARKS (Special observations, etc.)

CHECK BAR (for wire weight) NORMAL CK. BAR
READING DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

ERnest BREAUX
OBSERVER: US ARmy CORP OF Engineers
SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO. 16-6394-8

WS FORM B-91
(12-93)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): MORGAN CITY
(River Station, if different):
MONTH: NOV
YR: 96
STATE: LA
COUNTY: ST, MARY
RIVER:
TIME (local) OF OBSERVATION RIVER:
TEMP: 0800
PRECIPITATION: 0800
STANDARD TIME IN USE: CENTRAL
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: FT.
FLOOD STAGE: FT.
NORMAL POOL STAGE: FT.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX	MIN	AT OBSN	PRECIPITATION 24 HR AMOUNTS Rain, melted snow, etc. (in. and hundredths)	Snow, ice pellets, hail (in. and tenths)	AT OBS. Snow, ice pellets, hail, ice on ground (in.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation	RIVER STAGE CONDITION	GAGE READING AT A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	83	69	70	0													
2	81	53	53	.19													
3	81	49	49	0													
4	62	46	51	0													
5	69	46	61	0													
6	78	60	62	0													
7	82	62	73	0													
8	80	53	53	1.75													
9	80	47	47	0													
10	80	45	47	0													
11	69	47	51	0													
12	72	49	53	0													
13	71	52	54	0													
14	73	53	55	0													
15	74	55	57	0													
16	73	57	62	0													
17	71	62	68	0													
18	75	65	65	.07													
19	78	65	69	.03													
20	77	63	64	.01													
21	78	63	70	.01													
22	78	57	57	0													
23	66	54	55	0													
24	73	55	62	0													
25	77	52	52	.45													
26	77	42	42	0													
27	51	37	38	0													
28	54	38	47	0													
29	67	47	61	0													
30	72	47	69	1.00													
31																	
✓			SUM														

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire weight) NORMAL CK. BAR

READING | DATE

OBSERVER: USCOE PERSONNEL

SUPERVISING OFFICE: NWSO/LCH

STATION INDEX NO: 16-6394-8

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): MORGAN CITY	(River Station, if different)	MONTH: Dec.	19 96
STATE: LA.	COUNTY: ST. MARY	RIVER	
TIME (local) OF OBSERVATION RIVER	TEMP. 0800	PRECIPITATION 0800	STANDARD TIME IN USE: CENTRAL
TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO Ft.	FLOOD STAGE Ft.	NORMAL POOL STAGE Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	RIVER STAGE Gage reading at ___ A.M.	Tendency	REMARKS (Special observations, etc.)
1	74	47	53	1.30											
2	55	41	43	0											
3	57	43	45	0											
4	67	44	53	0											
5	59	52	55	.10											
6	67	50	64	.04											
7	74	50	61	0											
8	74	52	53	0											
9	63	44	44	0											
10	69	43	54	0											
11	73	55	64	0											
12	65	65	65	0											
13	64	61	64	0			X								
14	74	59	56	0			X								
15	71	55	59	0											
16	71	57	65	.05											
18	52	42	42	.30											
19	43	27	27	.01											
20	41	26	30	0											
21	47	30	41	0											
22	65	41	59	0											
23	68	57	57	0			X								
24	74	55	63	0			X								
25	73	33	33	.34											
26	55	34	47	0											
27	68	47	69	3.53			X								
28	66	62	64	1.80			X								
29	72	62	65	.25			X								
30	M	M	M	1.40			X								Gages messed up. (? greasing)
31	M	M	M	0			X								Temp. gauge out
			SUM	9.22											

CHECK BAR (For wire weight) NORMAL CK. BAR — READING — DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Lew
U.S. Army Corps of Engineers

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA

STATION INDEX NO. 16-6394-8

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION: MORGAN CITY
STATE: LA
MONTH: JAN 19 92
TIME (local) OF OBSERVATION: TEMP. 0800 PRECIPITATION 0800
STANDARD TIME IN USE: CENTRAL
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. MAX	MIN	AT OBSN.	PRECIPITATION 24-HR AMOUNTS	Snow, ice pellets, hail, ice on ground	WEATHER: Fog
1	79	68	68	0.02		
2	64	56	50	0		
3	75	~~60~~	62	0	50	
4	73	~~67~~	67	0	62	
5	69	66	67	0		
6	76	[illegible]	[illegible]	0		
7	60	45	46	.12		
8	46	44	46	0.04		X
9	41	39	39	0.57		
10	44	35	41	.02		
11	60	31	31	0		
12	43	~~35~~	35	0	31	
13	38	34	34	.04		
14	40	33	33	.03		
15	53	33	48	0		
16	68	33	40	.20		
17	50	28	28	0		
18	50	28	32	0		
19	45	32	35	0		
20	61	34	42	0		X
21	66	40	53	0		
22	70	~~60~~	63	0	53	
23	71	59	59	.02		X
24	69	59	60	.24		
25	68	57	58	.26		
26	66	49	50	0		
27	70	49	65	0		
28	74	59	59	1.04		
29	60	39	41	.40		
30	45	40	42	0		
31	54	40	44	0		X
			SUM	2.94		

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (for wire weight) NORMAL CK. BAR
READING DATE

OBSERVER: Wesley J. Law
U.S Army Corps of Engineers

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO. 16-6394-8

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

X

STATION (Climatological): MORGAN City
MONTH: Feb. YR: 97
STATE: LA.
COUNTY: ST. MARY
TIME (local) OF OBSERVATION RIVER / TEMP: 0800 / PRECIPITATION: 0800
STANDARD TIME IN USE: CENTRAL
TYPE OF RIVER GAGE / ELEVATION OF RIVER GAGE ZERO: Ft. / FLOOD STAGE: Ft. / NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. MAX	MIN	AT OBSN	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (ins. and hundredths)	Snow, ice pellets, hail (ins. and tenths)	Snow, ice pellets, hail, ice on ground (ins.)	WEATHER Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	RIVER STAGE Condition	Gage reading at A.M.	Tendency	REMARKS
1	61	43	59	0												
2	69	59	61	0			X									
3	72	60	62	0												
4	73	62	67	0												
5	73	58	58	.73												
6	64	44	45	0												
7	57	45	52	0												
8	70	44	44	.03												
9	45	41	41	0												
10	46	40	41	.08												
11	50	38	38	0												
12	59	38	47	0												Two
13	51	46	47	2.00												
14	59	46	46	.17												
15	46	40	41	.06												
16	59	40	41	0												
17	63	41	49	0												
18	56	50	53	0												
19	72	59	60	0												
20	74	68	67	.06												
21	78	65	67	.23												
22	70	50	50	0												
23	70	52	52	0												
24	70	50	54	0												
25	55	50	54	.38												
26	66	51	66	.07												
27	74	55	55	0.02												
28	69	53	69	0.30												
29																
30																
31																
			SUM	4.33												

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

CHECK BAR (for wire weight) NORMAL CK. BAR — READING — DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

Wesley J. Law

OBSERVER: U.S. ARMY CORPS of ENGINEERS

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA

STATION INDEX NO.: 16-6394-8

STATION (Climatological): Morgan City
STATE: LA
COUNTY: St. Mary
MONTH: March 19 96
TIME (local) OF OBSERVATION: RIVER — TEMP. 0800 — PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE — ELEVATION OF RIVER GAGE ZERO Ft. — FLOOD STAGE Ft. — NORMAL POOL STAGE Ft.

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

Date	Temperature F. 24 hrs. ending at observation: Max	Min	At Obsn	Precipitation 24-hr amounts: Rain, melted snow, etc. (ins. and hundredths)	Snow, ice pellets, hail (ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (ins.)	Weather (Calendar Day): Fog	Remarks (Special observations, etc.)
1	51	39	40	.54				
2	49	36	38	0				
3	61	38	40	0			X	
4	68	40	53	0				
5	72	53	73	0				
6	73	60	67	0				
7	74	43	47	.18				
8	47	29	32	0.08				
9	43	27	29	0				
10	46	17	35	0				
11	52	23	38	0				
12	59	18	37	0				
13	65	30	50	0				
14	73	22	60	0				
15	78	56	60	0				
16	76	56	65	0				
18	78	62	62	0				Windgust upto 40mph
19	77	44	45	0				
20	62	28	42	0				
21	53	36	40	0				
22	62	41	48	0			X	
23	70	40	48	0				
24	71	48	63	0				
25	75	63	66	0				
26	80	51	51	0.30				
27	52	48	48	.28				
28	67	46	58	0				
29	70	46	56	0				
30	70	55	67	.04				
31	78	64	64	.07				
			SUM	1.49				

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a wavy line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark "X" for all types occurring each day. Fog — Ice Pellets — Glaze — Thunder — Hail — Damaging Winds — Time of observation if different from above

RIVER STAGE: CONDITION — GAGE READING AT ___ A.M. — TENDENCY

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire weight) NORMAL CK. BAR — READING — DATE

OBSERVER: Jerry R. Johans
U.S. ARMY CORPS OF ENGINEERS
SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO.: 16-6394-8

STATION (Climatological): MORGAN City (River Station, if different)

MONTH: APRIL 1/30 19 97

STATE: LA. COUNTY: ST MARY RIVER:

TIME (local) OF OBSERVATION RIVER — TEMP. 0800 – PRECIPITATION 0800 — STANDARD TIME IN USE: Central

TYPE OF RIVER GAGE — ELEVATION OF RIVER GAGE ZERO Ft. — FLOOD STAGE Ft. — NORMAL POOL STAGE Ft.

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

X

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (in. and hundredths)	Snow, ice pellets, hail (in. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (in.)	REMARKS (Special observations, etc.)
1	65	55	60	0.03			
2	69	58	60	0			
3	73	60	63	0			
4	72	63	70	0			
5	75	63	73	.05			
6	73	59	59	1.27			
7	80	59	62	0			
8	[redacted]						
9							
10	75	63	58	0			
11	76	58	67	.33			
12	69	61	64	5.70			
13	69	49	50	.07			
14	56	49	50	0			
15	58	49	58	0			
17	'73	57	56	0			
18	75	50	50	0			
19	"	"	"	0			POWER OUTAGE DUE TO CONSTRUCTION
20							
21							
22							
23	77	57	57	0			
24	75	56	58	0			
25	71	59	62	0.20			
26	70	57	60	0.53			
27	71	60	70	0.25			
28	78	60	61	0.03			
29	64	54	54	0.03			
30	74	58	64	0			
31							
✓			SUM	8.46			

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a wavy line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark "X" for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire-weight) NORMAL CK. BAR — READING — DATE

ERNEST BREAUX

OBSERVER: US CORP OF Engineers

SUPERVISING OFFICE: NWSO LAKE CHARLES, LA

STATION INDEX NO. 16-6394-8

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Morgan City
STATE: La
COUNTY: St. Mary
MONTH: May 19 97
TIME (local) OF OBSERVATION: TEMP. 0800 PRECIPITATION 0800
STANDARD TIME IN USE: Central
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F — 24 HRS. ENDING AT OBSERVATION — MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS — Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)
1	75	65	68	0		
2	82	65	73	0		
3	81	68	68	.16		
4	79	62	62	0		
5	79	57	58	0		
6	76	58	62	0		
7	77	62	64	0		
8	79	62	70	0		
9	80	68	68	0		
10	81	67	67	0		
11	68	60	64	0		
12	75	60	66	0		
13						
14	Ecbc		off			
15	76	64	70	0		
16	84	66	68	0.11		
18	84	66	70	0.03		
19	81	70	74	0.22		
20	72	72	74	0		
21	82	74	75	0		
22	83	69	70	0.25		
23	83	69	71	0		
24	84	71	75	0.13		
25	78	66	68	2.21		
26	82	64	76	1.00		
27	*83	64	76	0		
28	86	64	75	0		
29	86	69	69	1.39		
30	81	69	71	.05		
31	82	69	76	.57		
✓			SUM	6.15		

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (∿∿) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark "X" for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

REMARKS (Special observations, etc.)

CHECK BAR (For wire weight) NORMAL CK. BAR ___ READING ___ DATE

CONDITION OF RIVER AT GAGE

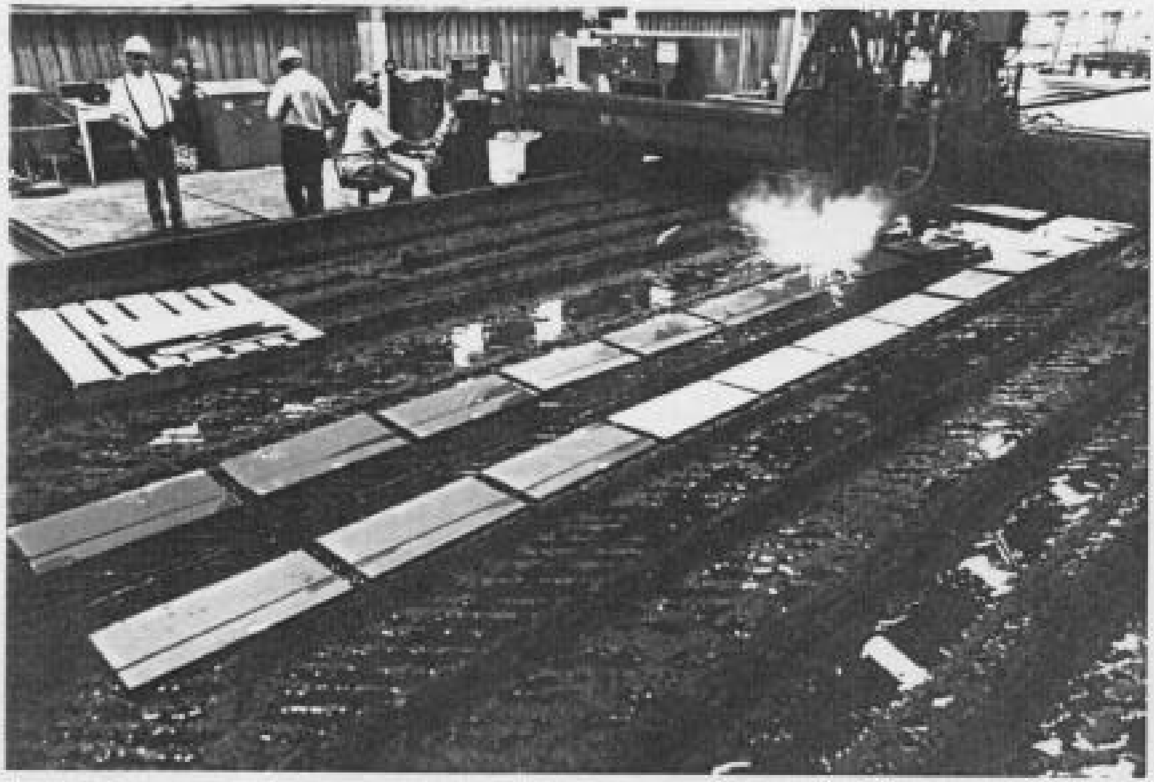
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Wesley J. Law
U.S. Army Corps of Engineers

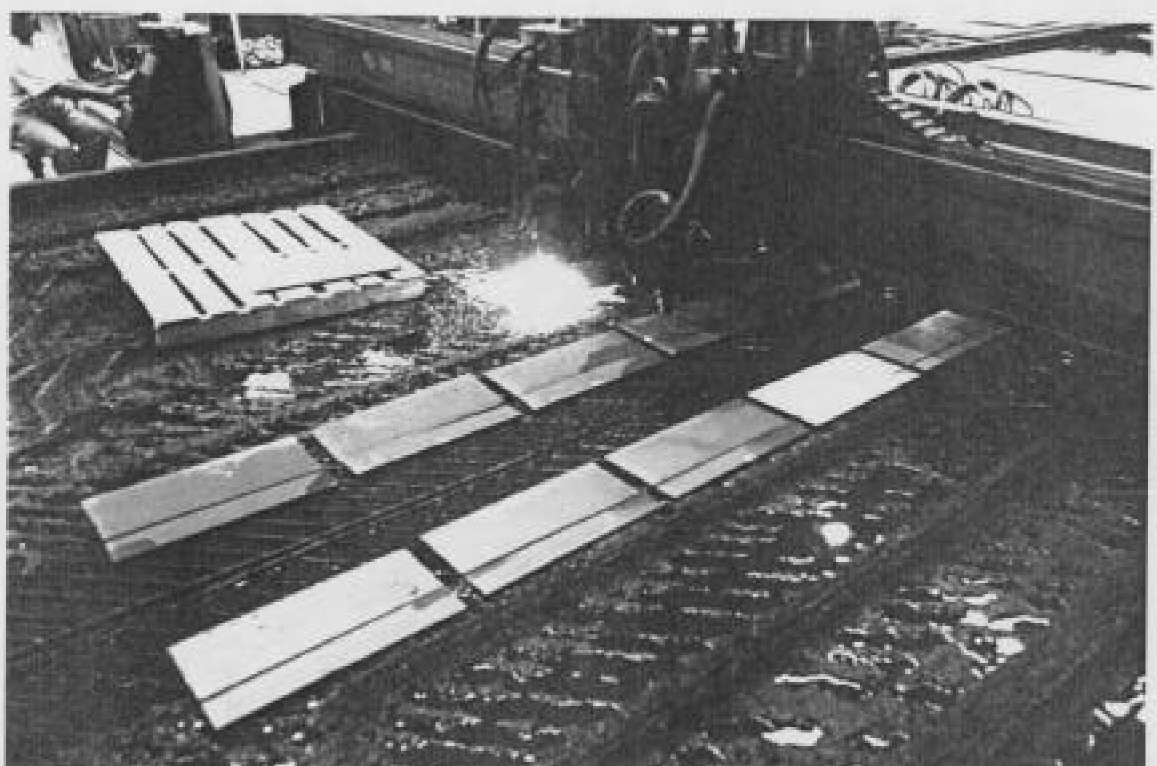
SUPERVISING OFFICE: NWSO LAKE CHARLES, LA
STATION INDEX NO.: 16-6394-8

APPENDIX 3-1

Photographs Showing the Plasma Torch Cutting Trials and Severed Panels in Project Task 3

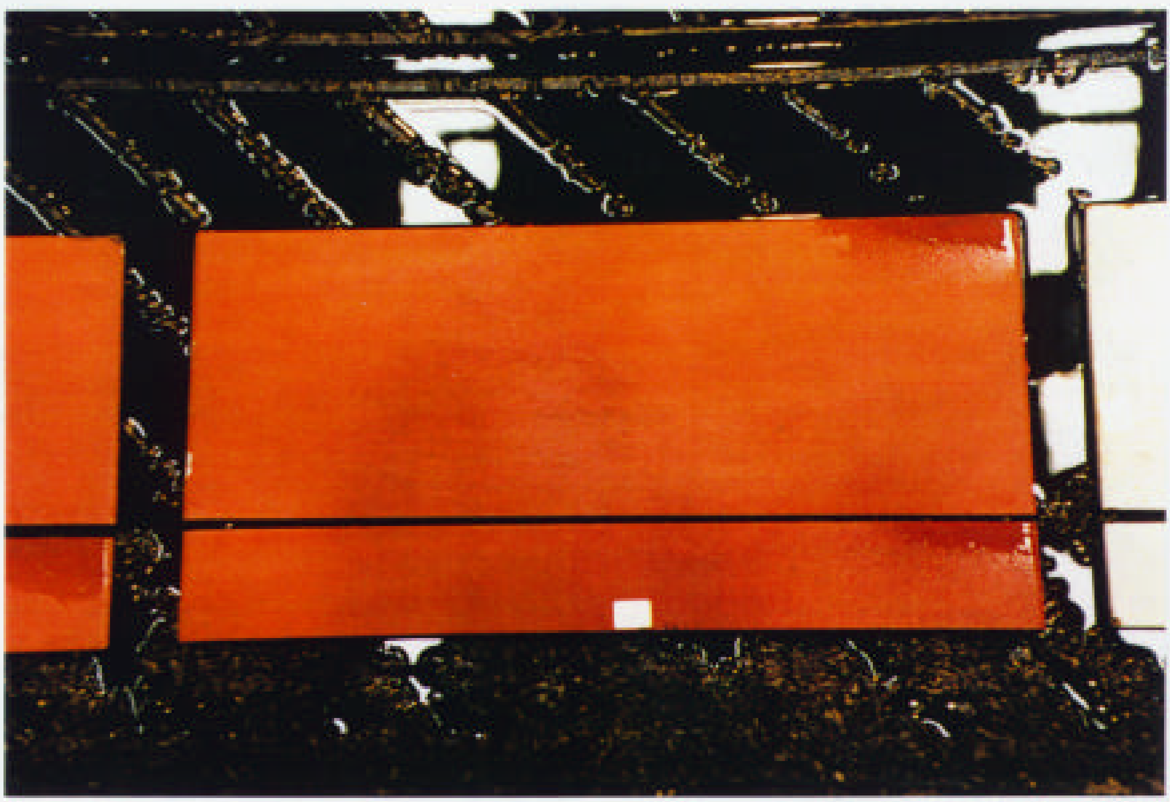


Coated panels being severed by an automated plasma torch cutting machine at the McDermott Shipyard.

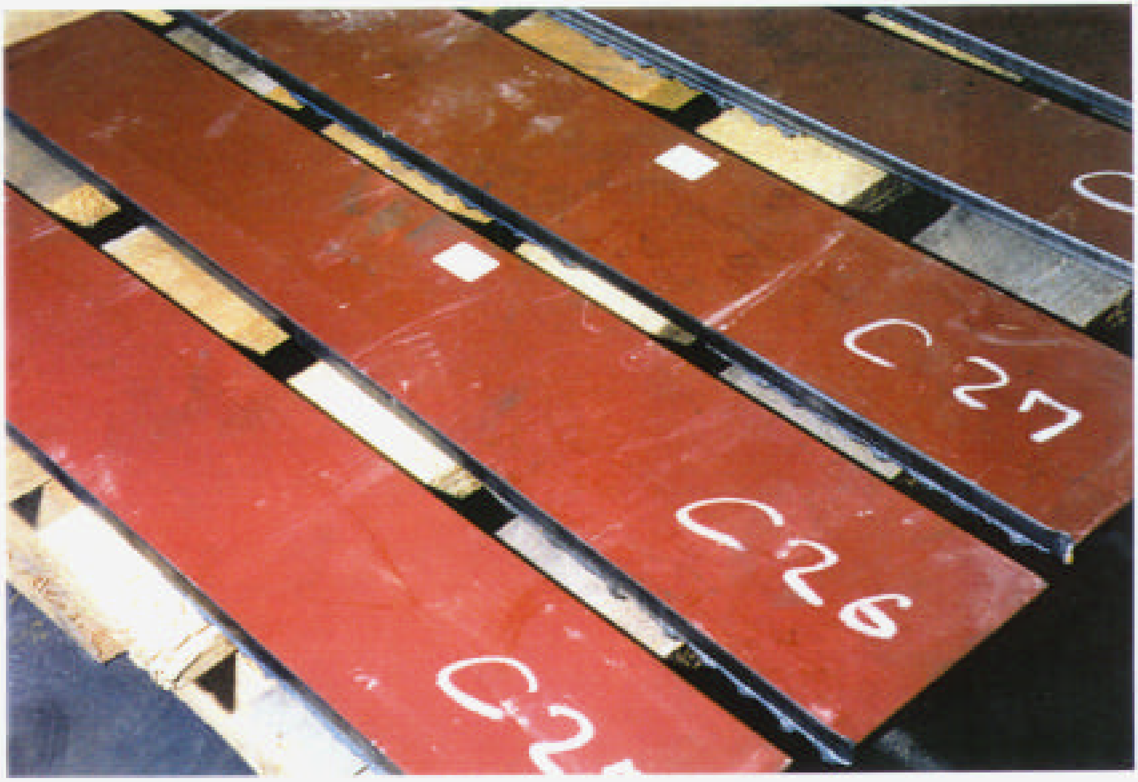


A closer view of the coated panels being cut by an automated plasma torch.

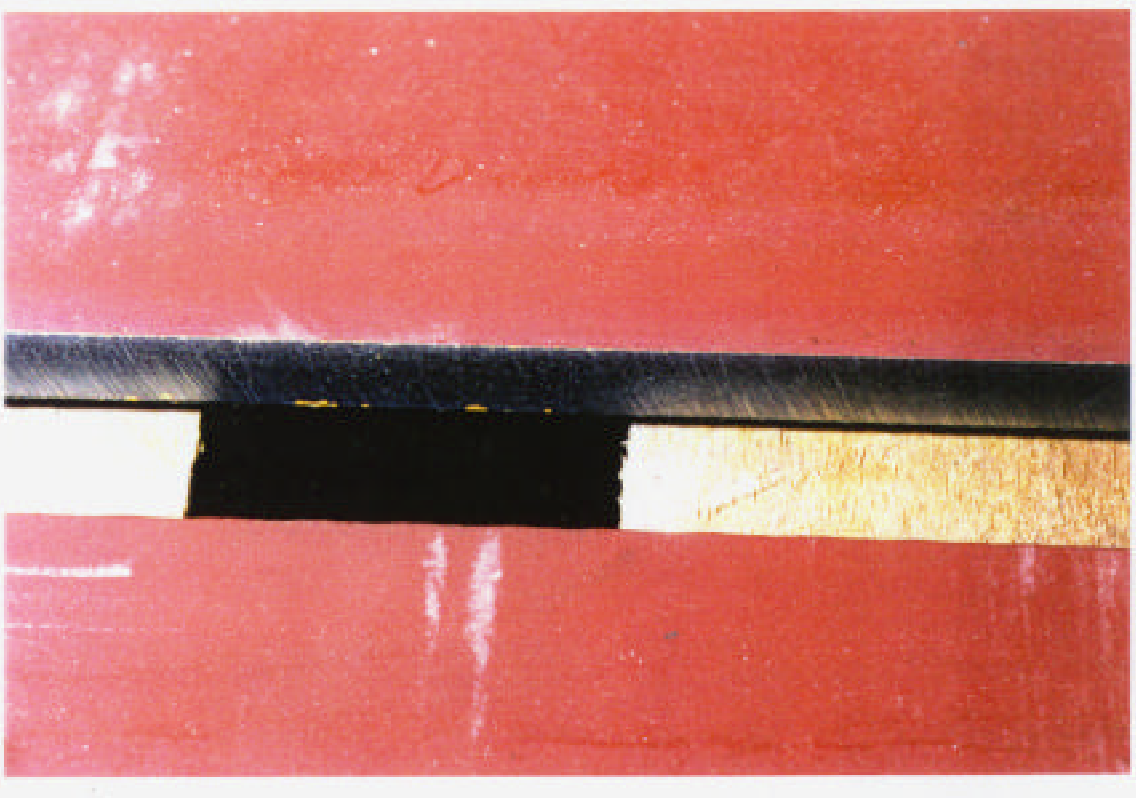
Production workers at the McDermott Shipyard retrieving the severed panels after cutting.



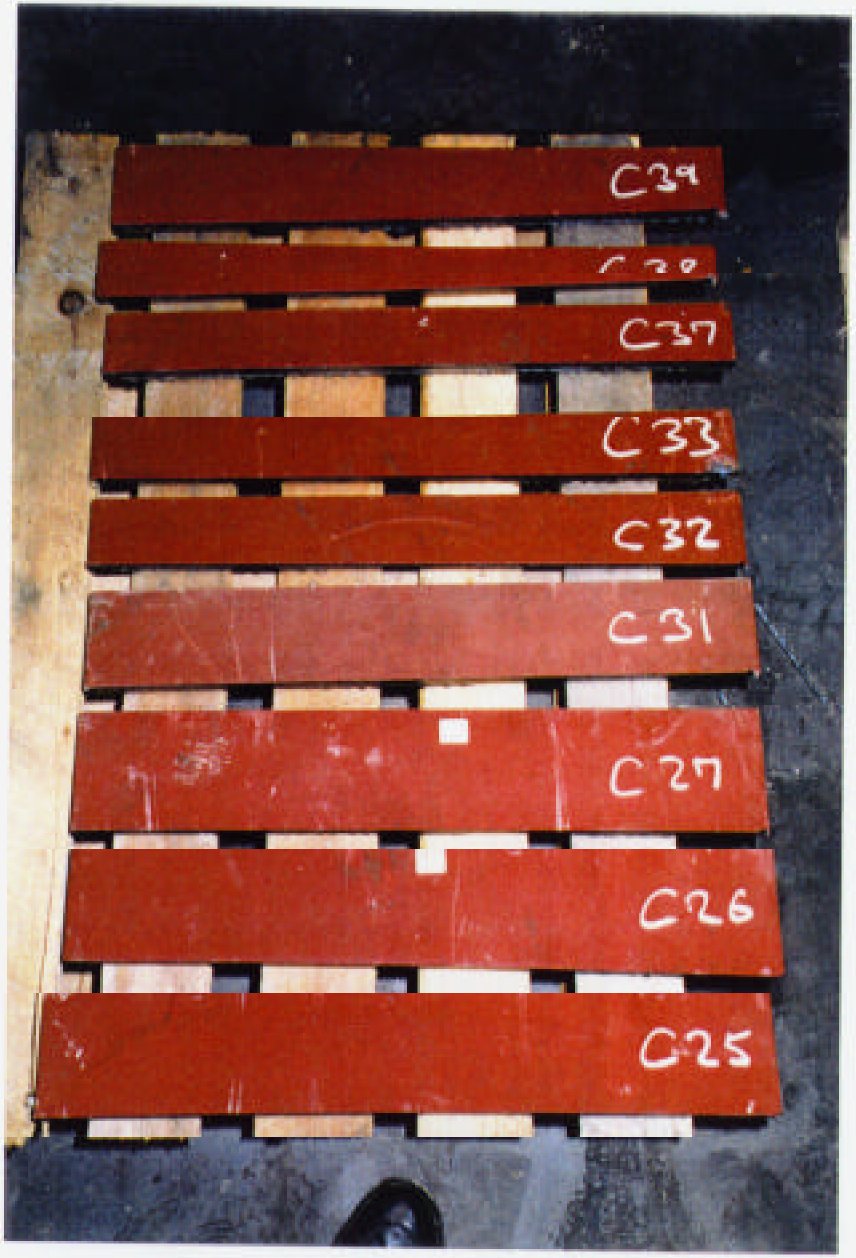
Top view of panel C3 after plasma torch cutting.

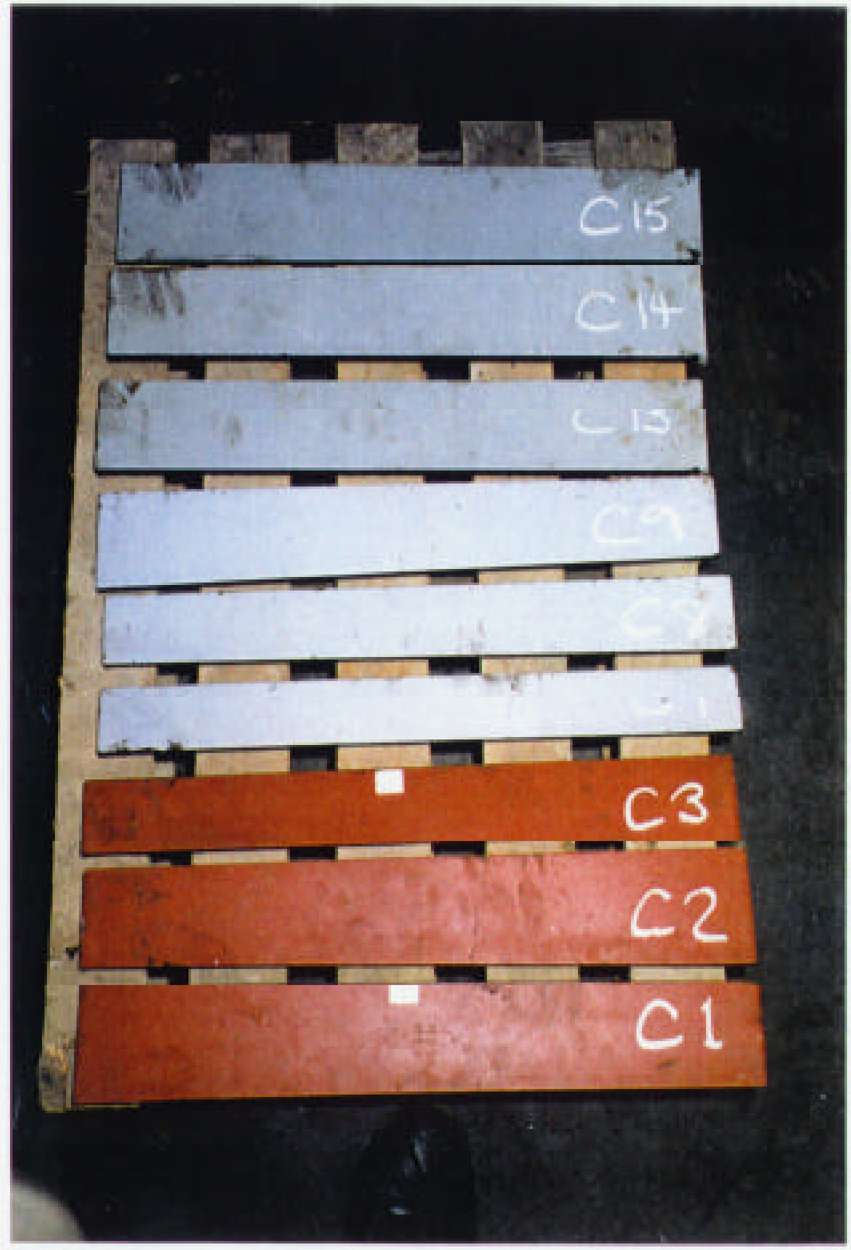


Oblique view showing the cut surfaces of panels C25, C26, C27, C31, and C32.

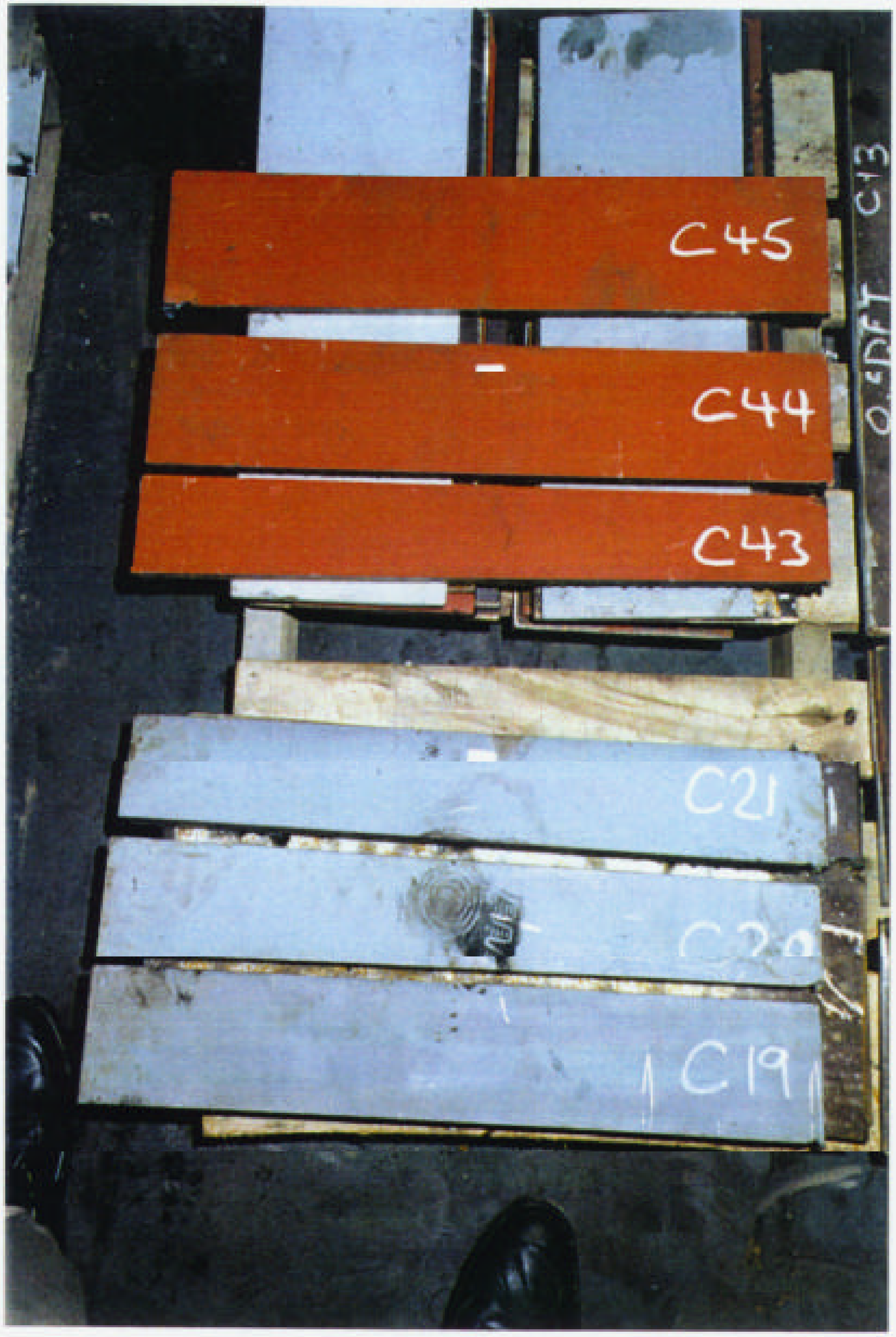


Close-up, oblique view showing the cut surface of panel C26.





Photographs showing panels (with identification markings, see Table 3-2) after being cut with an automated plasma torch.



Photograph showing panels (with identification markings, see Table 3-2) after being cut with an automated plasma torch.

APPENDIX 3-2

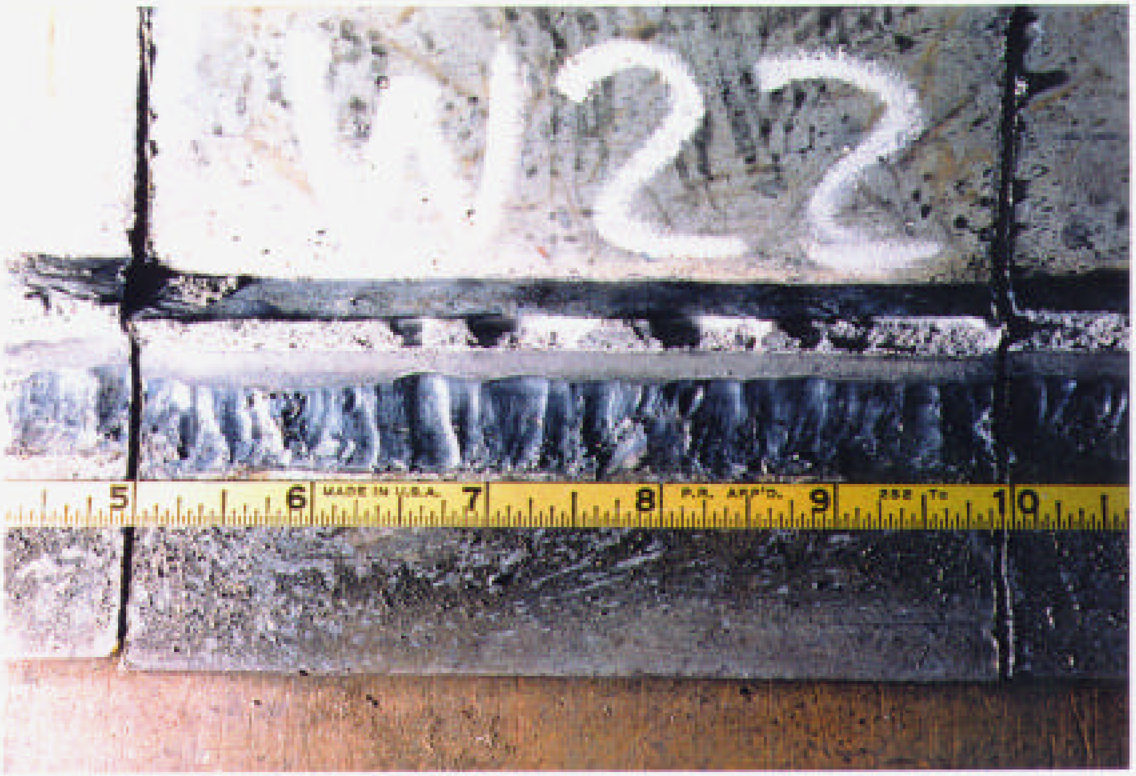
Photographs Showing Results of Bend Tests Conducted on Welded Panels in Task 4

Photograph showing linear porosity along the fusion centerline of panel W5 (see Table 3-3, Amercoat 3207).

Photograph showing linear porosity along the fusion centerline of panel W6 (see Table 3-3, Amercoat 3207).

Photograph showing linear porosity along the fusion centerline of panel W10 (see Table 3-3, Carboline 8101).

Photograph showing linear porosity along the fusion centerlines of panels W11 and W16 (see Table 3-3, Carboline 8101 and Nippe Ceramo).

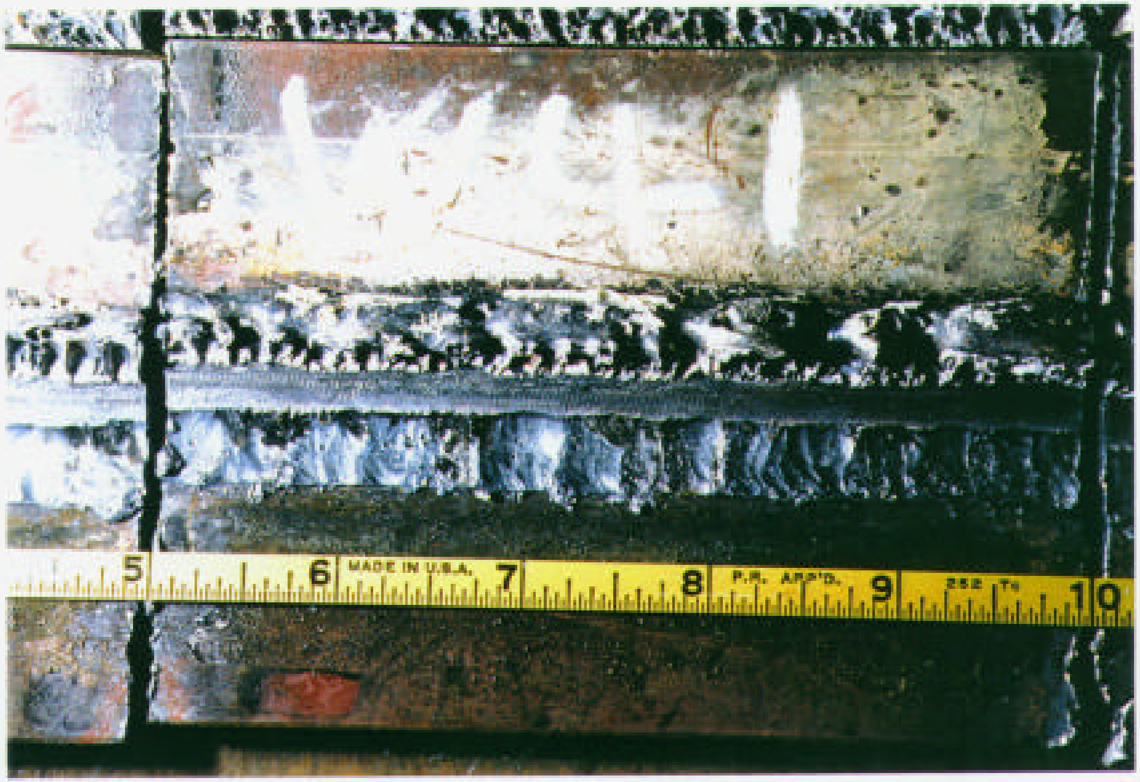


Photograph showing linear porosity along the fusion centerline of panel W22 (see Table 3-3, Int'l Zinc WB14A).

Photograph showing linear porosity along the fusion centerline of panel W28 (see Table 3-3, Intergard 292 WB).

Photograph showing linear porosity along the fusion centerline of panel W36 (see Table 3-3, Sovaprime 13R96).

Photograph showing linear porosity along the fusion centerline of panel W40 (see Table 3-3, Hemudur 18580).



Photograph showing linear porosity along the fusion centerline of panel W41 (see Table 3-3, Hemudur 18580).

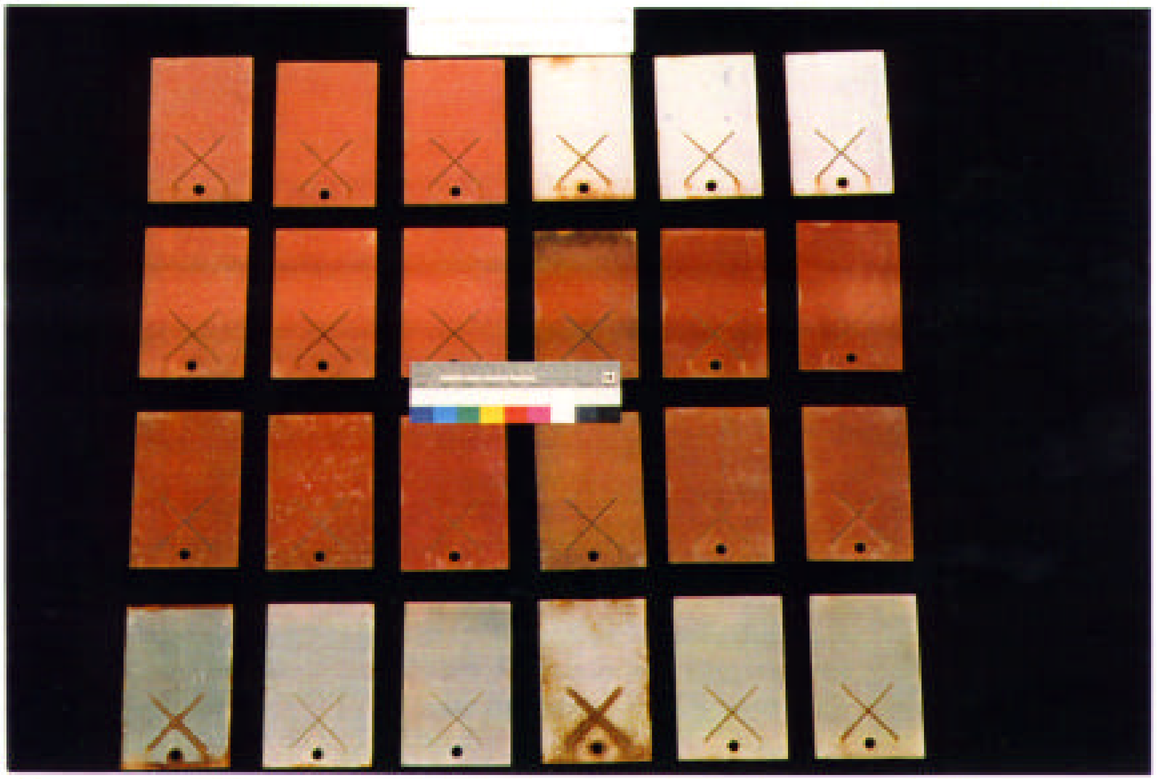
Photograph showing linear porosity along the fusion centerline of panel W42 (see Table 3-3, Hemudur 18580).

Photograph showing linear porosity along the fusion centerline of panel W47 (see Table 3-3, Devran 720).

Photograph showing linear porosity along the fusion centerline of panel W48 (see Table 3-3, Devran 720).

APPENDIX 3-3

Photographs Showing Atmospheric Exposure Test Panels after 12 Months of Continuous Testing



Photograph of the primer-coated atmospheric exposure test panels after twelve months of testing at the Bollinger Shipyard (formerly the McDermott Shipyard) in Amelia, LA.

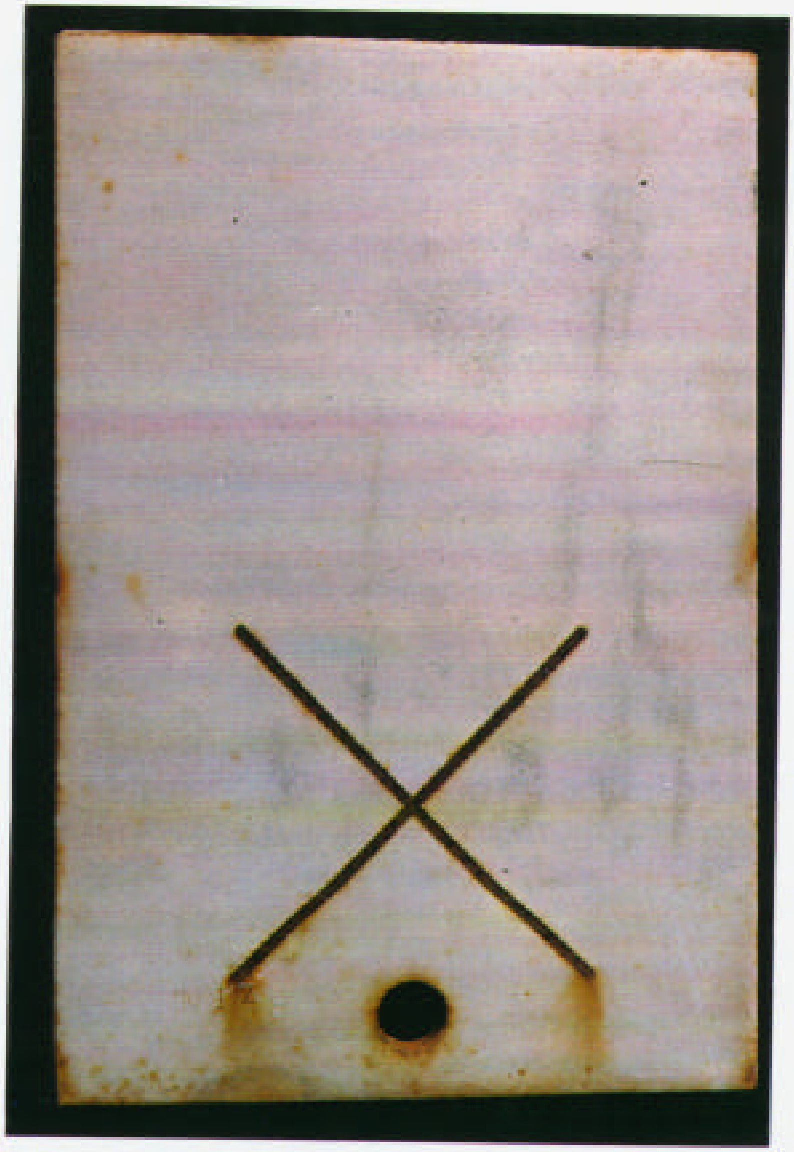
Panel No:	**N14**
Primer:	**Amercoat 3207**
DFT (mils):	**0.5**
Rating:	**7**

Panel No:	**N8**
Primer:	**Amercoat 3207**
DFT (mils):	**1.0**
Rating:	**9**

Panel No:	**N23**
Primer:	**Amercoat 3207**
DFT (mils):	**1.5**
Rating:	**9**

Panel No:	N30
Primer:	Carboline 8101
DFT (mils):	0.5
Rating:	5

Panel No:	**N27**
Primer:	**Carboline 8101**
DFT (mils):	**0.9**
Rating:	**6**



Panel No:	**N148**
Primer:	**Carboline 8101**
DFT (mils):	**1.4**
Rating:	**7**

Panel No:	**N169**
Primer:	**Devran 720**
DFT (mils):	**0.5**
Rating:	**6**

Panel No:	N168
Primer:	Devran 720
DFT (mils):	0.9
Rating:	6

Panel No:	**N173**
Primer:	**Devran 720**
DFT (mils):	**1.7**
Rating:	**9**

Panel No:	**N125**
Primer:	**Hemudur 18580**
DFT (mils):	**0.5**
Rating:	**2**

Panel No:	**N119**
Primer:	**Hemudur 18580**
DFT (mils):	**1.0**
Rating:	**7**

Panel No:	**N157**
Primer:	**Hemudur 18580**
DFT (mils):	**1.5**
Rating:	**8**

Panel No:	N82
Primer:	Intergard 292 WB
DFT (mils):	0.7
Rating:	2

Panel No: N75
Primer: Intergard 292 WB
DFT (mils): 1.1
Rating: 2

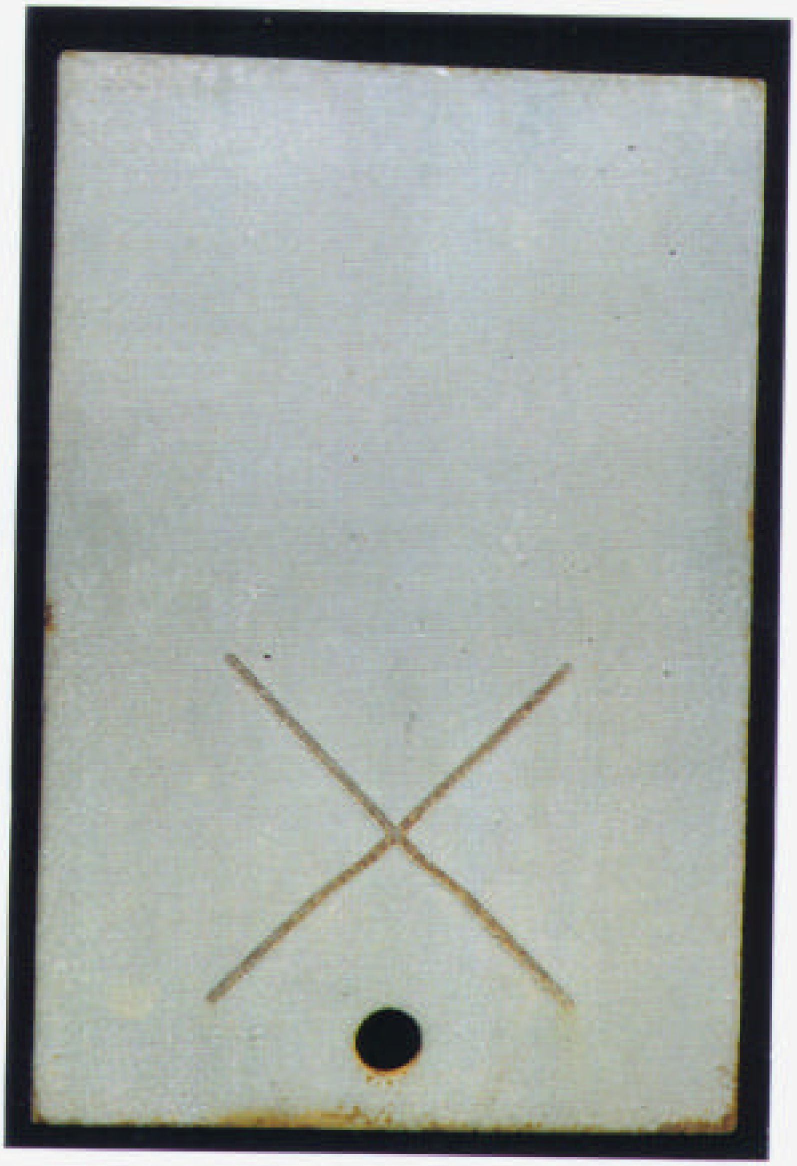
Panel No: N83
Primer: Intergard 292 WB
DFT (mils): 1.5
Rating: 6

Panel No:	**N150**
Primer:	**Sovaprime 13R96**
DFT (mils):	**0.5**
Rating:	**1**

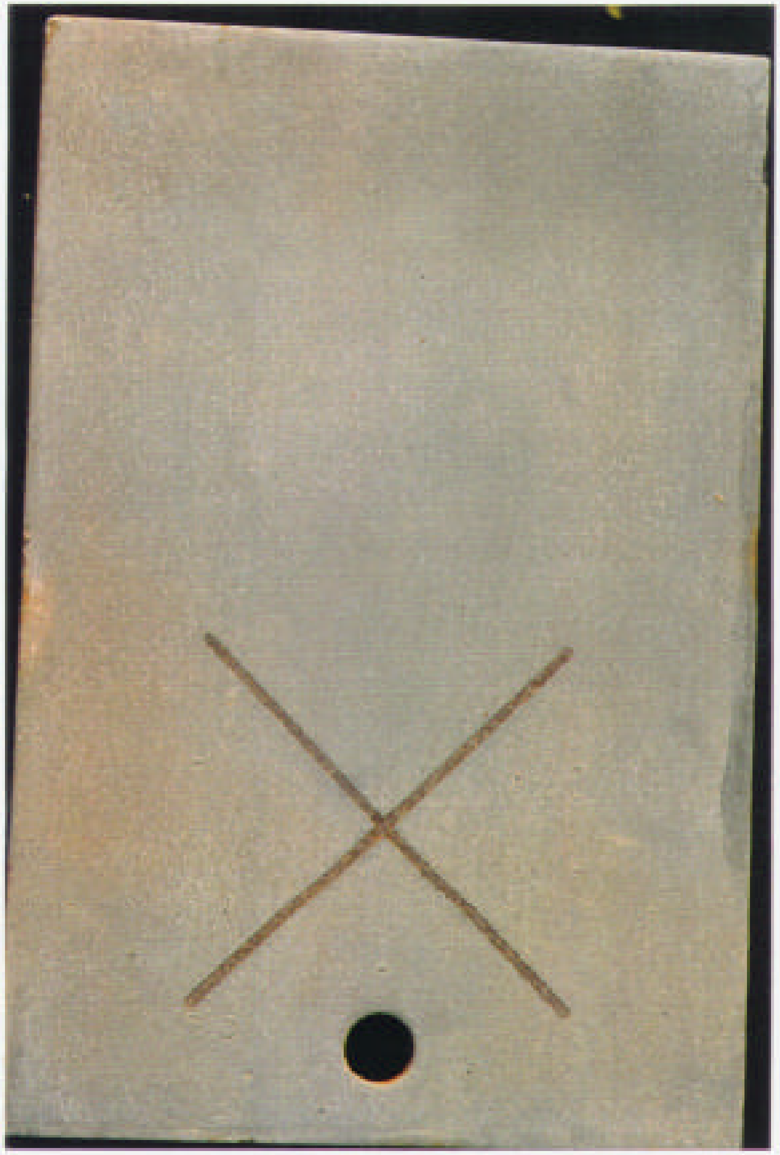
Panel No:	**N95**
Primer:	**Sovaprime 13R96**
DFT (mils):	**1.0**
Rating:	**5**

Panel No:	**N155**
Primer:	**Sovaprime 13R96**
DFT (mils):	**1.4**
Rating:	**5**

Panel No:	N133
Primer:	Int. Zinc WB14A
DFT (mils):	0.5
Rating:	7

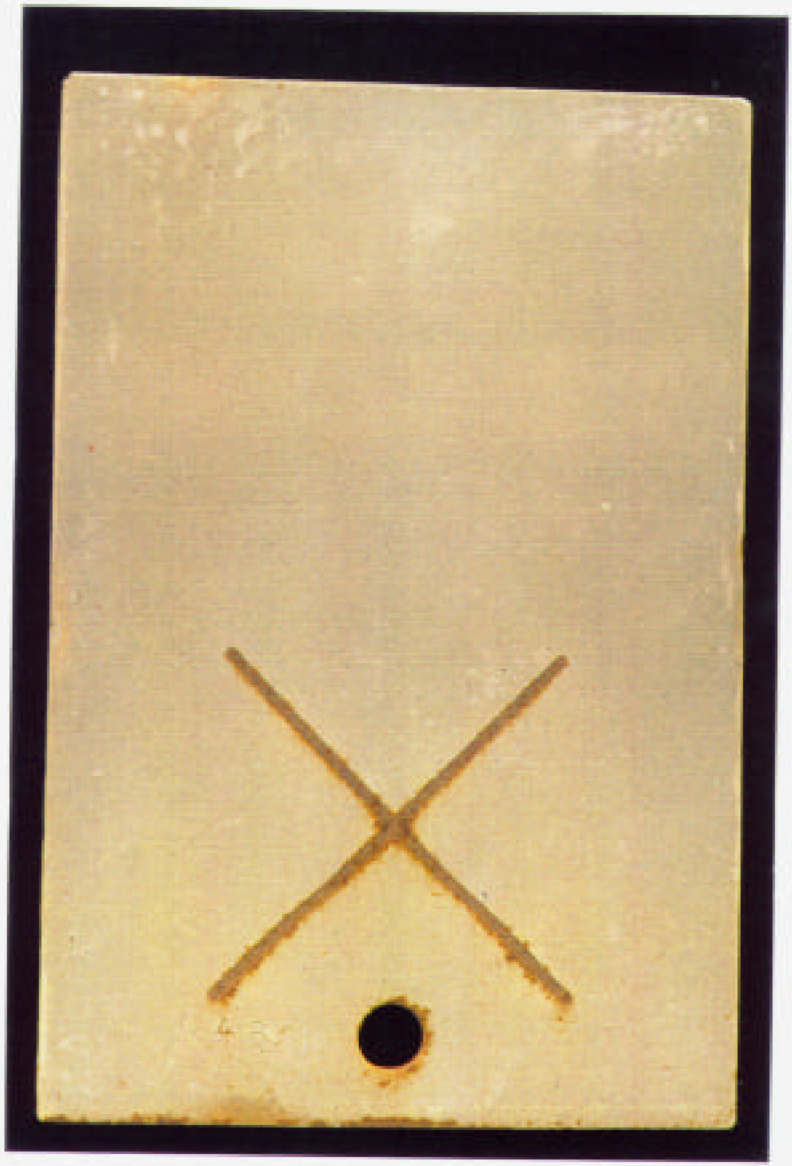


Panel No: N66
Primer: Int. Zinc WB14A
DFT (mils): 1.0
Rating: 9

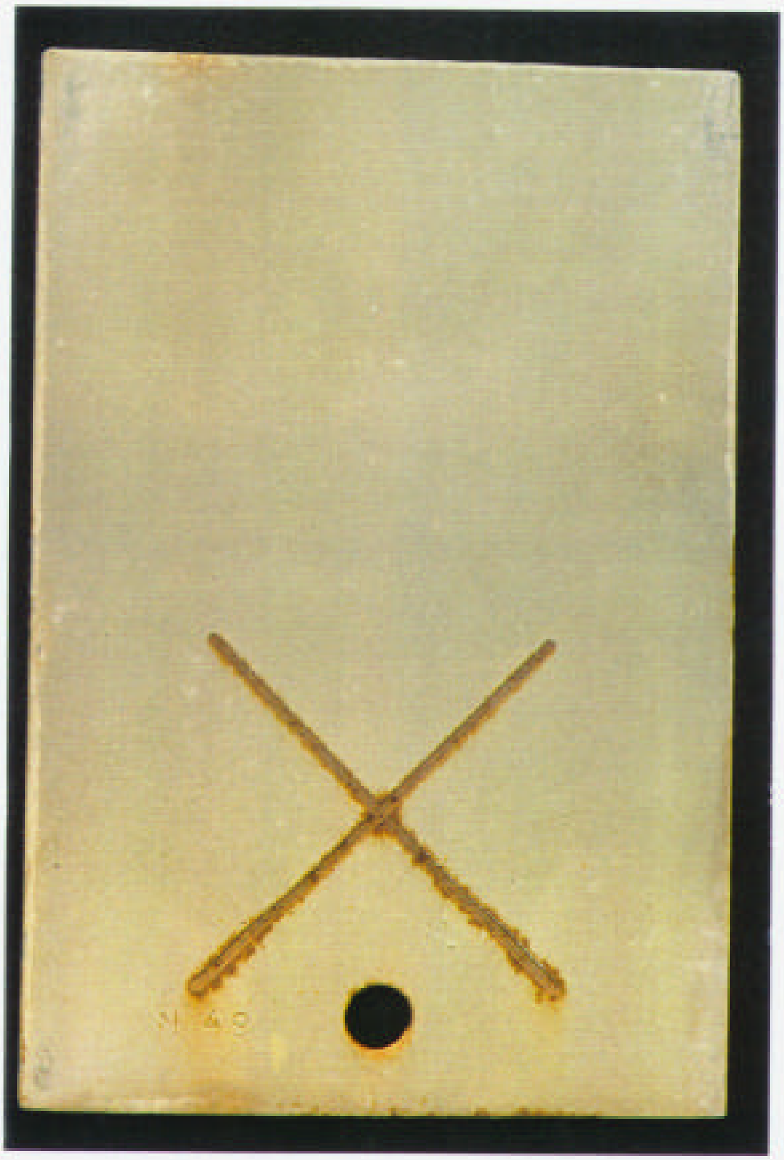


Panel No:	**N55**
Primer:	**Int. Zinc WB14A**
DFT (mils):	**1.5**
Rating:	**9**

Panel No:	**N165**
Primer:	**Nippe Ceramo**
DFT (mils):	**0.5**
Rating:	**1**



Panel No:	N48
Primer:	Nippe Ceramo
DFT (mils):	1.2
Rating:	9



Panel No:	**N49**
Primer:	**Nippe Ceramo**
DFT (mils):	**1.5**
Rating:	**9**

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